# Marine Engineering
## and Shipping Age

**Volume XXXIII** **October, 1928** **Number 10**

Published Monthly by the
**SIMMONS-BOARDMAN PUBLISHING COMPANY**
34 North Crystal Street, East Stroudsburg, Pa., with executive offices at 30 Church Street, New York
H. H. Brown, Editor
L. S. Blodgett, Managing Editor
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Subscription price: United States, Canada and Mexico, $3.00; foreign countries, $4.00. Single copy, 35 cents.

Marine Engineering and Shipping Age is a member of the Associated Business Papers, Inc. (A. B. P.), and the Audit Bureau of Circulations (A. B. C.).

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## Shipbuilding Prospects

THAT the promise of a considerable amount of new work for the shipyards, which was held out earlier this year by the passage of the Jones-White bill, will soon be fulfilled is shown by the fact that plans and specifications for 20 new vessels have already been completed while the designs of 22 additional vessels are in the process of development, some of which are nearing completion so that they will soon be ready for submission to the shipyards for bids. All of this preliminary work can be looked upon as the beginning of a new period of activity in the shipbuilding industry, which is likely to continue for some time to come. Considerable time has necessarily elapsed before any actual construction could be started in order to enable the shipowners to comply with the beneficial provisions of the bill. This delay, in view of the size and importance of the proposals under consideration, was to be expected. Progress is being made, however, in the award of mail contracts and several applications have been received by the Shipping Board for loans for the construction of new vessels while a number of other shipowners are negotiating for loans. Keen competition in bidding for the new contracts will naturally follow but shipowners must realize that the cost of building the type of vessels designed to meet the requirements of the new legislation cannot be measured by the costs of the slower cargo vessels with which they are more familiar. For this reason we recommend a careful study of the statements of the National Council of American Shipbuilders, published elsewhere in this issue, regarding the status of shipbuilding prices and the effect of the speed of a vessel upon its cost of construction.

## French Shipbuilding

FOR some time the shipbuilders in France have been in the depths of despair over the lack of new business. To remedy the situation, the French government enacted on July 6 a bill providing for the establishment of the Credit Maritime. This is the first step looking toward the encouragement of shipbuilding that has been taken by the French Government since 1906, but so far there is little prospect that the shipbuilders will receive any material benefit from the new law. In accordance with the new scheme the Credit Foncier, a bank specializing in mortgages and loans, is authorized to lend to French shipowners sums totaling 200,000,000 francs a year during a period of 5 years. The loans are to be refunded within 20 years and the rate of interest at present is about 9 percent, one-half of which is to be paid by the shipowners and the other half by the State. It is generally believed that this scheme, however well meant, will be of little help to either the shipowners or the shipbuilders for two reasons; first, because the rate of interest is high, and, second, because French shipowners are authorized to place orders abroad when foreign quotations are 15 percent lower than French prices. Since the new law went into effect several important orders have been placed with a British yard and one of the large French shipyards is going into liquidation.

## The United States Lines

IN the past few years, this paper has, a number of times, taken the occasion to remark upon the very excellent service rendered by the United States Lines. It is quite safe to say that nowhere are better meals served or more careful and courteous attention given to meeting and anticipating the requirements of the most exacting traveler than on the *Leviathan* and that the character of service rendered by the other and smaller vessels of the line will bear the most searching



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comparison with any foreign vessels of their class. The line has become, in a sense, a national institution, it has established a "good will" of great value and its future is a matter of very material interest to the whole country.

It has long been known to operators of transatlantic passenger tonnage, and the fact is now recognized by those less familiar with this particular division of the shipping business, that if the United States Lines is to continue in business as a competitive and "going" concern it will have to acquire new and modern tonnage in the very near future.

There does not appear to be any great likelihood that the Government itself will undertake the construction of large passenger liners; the present administration is clearly in favor of the policy of "getting the Government out of shipping" in the shortest possible time and in line with this the United States Lines is now offered for sale to private parties.

If the line is to hold its present position in the face of the competition of the new ships which are rapidly making their appearance in the foreign-flag lines, it will need, at once, two large vessels to run with the *Leviathan*—vessels offering accommodations and service at least equal to what is now to be found on that ship. Two such vessels would probably cost in the neighborhood of $30,000,000. Three-quarters of this amount, or $22,500,000, could be borrowed from the Government at perhaps 3 percent, while the remainder would have to be furnished by the new owners of the line at a cost of 6 percent, thus making a total interest charge of $1,125,000. Depreciation and insurance added to the interest on the money invested would give a total carrying charge in the neighborhood of $3,500,000 per year on the two ships or approximately $1,250,000 on each vessel.

The *Leviathan* is reported to have earned a gross profit of $500,000 per year, which means, presumably, that the income from her operation exceeds the operating charges by this amount, no account being taken of interest, depreciation and insurance. If this assumption is correct, each of the new ships would have to earn $750,000 a year in excess of what is now turned in by the *Leviathan* in order to break even. Undoubtedly new vessels would be more economical to operate and certain other savings could probably be realized from private as against government operation. It looks like a "pretty close fit" but an experienced and well-organized steamship line with sufficient financial backing to carry it over the slack seasons which are bound to occur would at least have a fair fighting chance of success.

To give up the only American transatlantic passenger line, particularly in view of the excellent reputation which it has succeeded in establishing, would be little short of a national calamity. It is sincerely to be hoped that one of our experienced operating companies may see its way clear to undertake the carrying on of the line.

# Demands on Material by the Modern Steam Plant

THE tendency in steam engineering, both afloat and ashore, has been steadily toward higher pressures. Until the advent of the turbine, the most obvious and indeed the only practical method of materially increasing the economy of the engine was by increasing pressure, thus taking advantage, to the greatest possible extent, of the expansive property of steam. As the lower end of the scale was limited by the inability of the reciprocating engine to profit fully by high vacuum, the range of expansion could be extended only by higher initial pressure. The degree of expansion which could be handled economically by a single cylinder or simple engine being reached, the compound engine made its appearance, and this, following the line of development so clearly indicated, was soon superseded by the triple expansion engine. Here, so far as type of engine was concerned, progress paused. Some quadruple engines were, and still are, built, but the actual net gain with each of these successive modifications of type is relatively less, greater mechanical complexity and increased first cost tending to offset the undoubted thermodynamic gain resulting from higher pressures and correspondingly greater ratios of expansion.

The turbine made possible the utilization of the lower part of the expansion curve, material increase in economy being thus obtained without further increase of initial pressure but, on the other hand, its introduction led to a greater use of superheat.

The increment in pressure as between the simple engines of perhaps 50 years ago and the modern triple, quadruple or turbine, while accompanied by a considerable rise in the temperature of the steam, has not been such as to affect very materially the physical qualities of the iron, steel and other metals with which the steam comes in contact. It is true that increasing pressure, coupled with the ever-present necessity of keeping the weight of marine engines within reasonable bounds has tended toward larger unit stresses and has made strength and uniformity of quality most essential characteristics of both boiler and engine materials but the maximum steam temperature in the vast majority of marine steam plants is not yet sufficient to cause a material change in the properties of iron and steel as indicated by the ordinary physical tests.

Higher pressures than are ever found on shipboard have for some time been used in certain shore power stations and, through the use of superheaters, temperatures which are relatively even higher are not uncommon in these stationary plants. While it is fair to presume that the ordinary "advancement of the art" would eventually have brought about similar developments in marine plants, it is the injection into the problem of ship propulsion of an entirely new and hitherto outside factor which has brought marine engineers face to face

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with the necessity for higher pressures and temperatures and their attendant difficulties.

It is becoming increasingly evident to every broad-minded marine engineer that if the steam engine, either reciprocating or turbine, is not to be superseded by internal-combustion machinery in many of the various services in which it is now employed, its economy of operation will have to be materially increased above the average which at present obtains. Furthermore, it appears equally apparent that this increase in efficiency must come as the result, in large part, of higher steam temperatures.

The temperatures corresponding to the pressures in general use in marine plants for the past decade range from 375 to 400 degrees F. While these temperatures have made necessary special provisions for lubrication and for the composition of such lubricants as come into direct contact with the steam, and also have led to the development of improved types of rod and piston packing, etc., they are not sufficient to produce any appreciable change in the molecular structure of iron and steel. During this same period, superheat has been adopted but in more or less isolated cases and in general to what, in view of present proposals, appears a very limited extent.

In the past five or six years, Diesel competition has put a very different face on the whole matter, higher pressures and temperatures evidently must come if steam propulsion is to continue in general use in ships and a most pressing question with marine engineers is the determination of the practical limits of this development. Really this question seems to resolve itself into two parts—what is the limiting increase in pressure above present practice from which appreciable gain may be looked for and what limit may be placed upon increasing temperatures by their prejudicial effect upon those metals which it appears commercially possible to make use of in the construction of steam machinery.

At least a partial answer to these questions is found in the report of the investigations of Professors Mellanby and Kerr of Great Britain. In the matter of pressure these gentlemen are of the opinion that the upper limit of pressure, beyond which any real gain in economy will be relatively small, is in the neighborhood of 1250 pounds per square inch. While the temperature corresponding to this pressure may not be sufficient to affect iron and steel very seriously, the enormous stresses set up by the pressure alone make necessary the use of very special material such as forged boiler drums, valve bodies, pipe fittings and flanges. It should be noted, however, that in a large plant the higher pressure, coupled with superheat, may reduce the number of boilers required and thus offset the additional cost of these special materials.

As regards the limit of temperature, Messrs. Mellanby and Kerr consider that the limit set by materials at present in use, even allowing for probable improvements in their quality, is approximately 900 degrees F.

Taking 900 degrees as a temperature which may have to be dealt with in the near future as a result of the increasing use of the superheater, it is of interest to note what effect it has, or may have, on the materials now generally used. It is known that ordinary mild steel boiler tube material, having a tensile strength of 50,000 to 55,000 pounds per square inch when tested at ordinary temperature, suffers when the test temperature is raised to around 900 degrees, the tensile strength being reduced to about 45,000 pounds per square inch. So far as the tests indicate, it would appear that this temperature does not reduce ultimate strength to the danger point but recent investigations show that, if high temperature and load continue to act for a considerable period of time, a creeping or flow of the metal takes place, which will eventually cause failure at a stress much lower than the ultimate strength as determined by ordinary methods of testing. It has also been found that there is a limiting stress corresponding to a given temperature, known as the limiting creep stress, below which creeping and consequent failure will take place.

The investigations of the effects of high temperatures upon boiler steel have not yet advanced to such a point as to be entirely conclusive, but they clearly indicate tendencies. Elsewhere in this issue will be found a reprint of a most interesting article which recently appeared in the *Liverpool Journal of Commerce*, giving a very clear idea of the present state of available knowledge on this subject.

It would appear that for the power house engineer, concerned, as he now is in many instances, with pressures well above 1000 pounds per square inch coupled with superheat, the question of temperature effect upon metals is a most pressing one. So far, the marine engineer is less concerned, for it does not now seem probable that such excessive pressures and temperatures will come into general use on shipboard, at any rate not in the near future. It is, however, quite probable that pressures as high as 500 pounds per square inch and steam temperatures of from 700 to 800 degrees F. will come into more or less general use. While these do not closely approach the conditions described in the article above referred to, they are sufficiently onerous to make necessary the very greatest care, both as to materials and workmanship, in the construction of boilers, piping and machinery which will have to withstand them.

The accident which occurred last fall on the high-pressure steamer *King George V* makes only too clear the amount of care necessary to the successful operation of high-pressure machinery on board ship. While this particular accident was not due to defective boiler material, but to scale formation and consequent overheating, the detail report of the accident gives a rather impressive picture of material subjected to most trying operative conditions.

Higher pressures and temperatures are "due" on shipboard and will undoubtedly make their appearance in increasing numbers of vessels, but their successful adoption is not the simple and easy matter which some engineers would have one believe.

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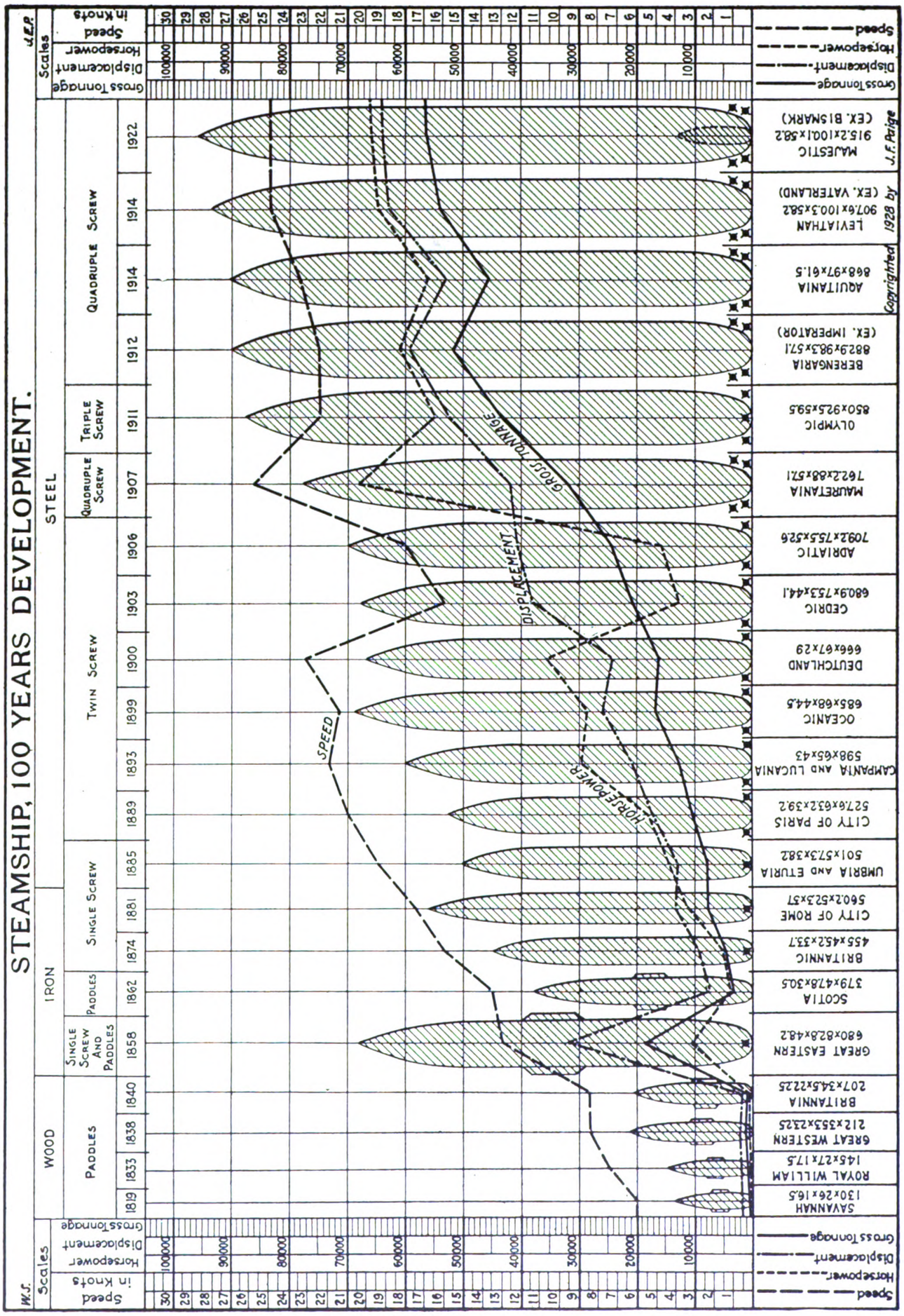


Chart prepared by Mr. J. F. Paige, formerly operating manager of the Black Diamond Steamship Corporation, New York city, showing 100 years' development in transatlantic steamships

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# The Status of Shipbuilding Prices*

## Quotations for new ships fully justified by advances in material and labor costs

A NUMBER of our well-known shipping journals have more or less frequently of late recorded what they feel is a very general impression among shipowners and ship operators, namely, that the selling price of the modern ship built in America is far too high. Such a contention, while trivial in itself, ignores two primary factors in the cost of construction of modern steam and motor ships and should not be allowed to become a popular misconception. The pressent burdens of the shipbuilder are already heavier in most cases than he can bear.

Impartial investigation of the trend of shipbuilding prices in this country will show that the quotations now being made on new construction by the leading shipyards of the United States are fully justified. This conclusion has been arrived at by first studying the cost-trend of ships built in this country from 1914 to date and comparing the increase in price shown with the increase in cost of materials and labor in the United States as reported for this period by the United States Department of Labor Statistical Bureau.

### The Increase in Cost of Materials and Labor

In Fig. 1 have been plotted the index numbers for the wholesale prices of three commodity groups, selected as covering in a general way the same class of materials that enter into ship construction. It will be noted that the price of building materials was 71 percent higher in 1927 than in 1914; metals and metal products, 35 percent higher; and machinery, 73 percent higher. These three curves have been averaged or combined in a fourth curve by giving weight to the fact that materials under these three general headings enter into the construction of say a 10,000-deadweight-ton cargo ship in about the following percentages: Metals and metal products, 47 percent; building materials, 17 percent; machinery, 36 percent. This average curve shows that materials prices increased 55 percent over the 13-year period.

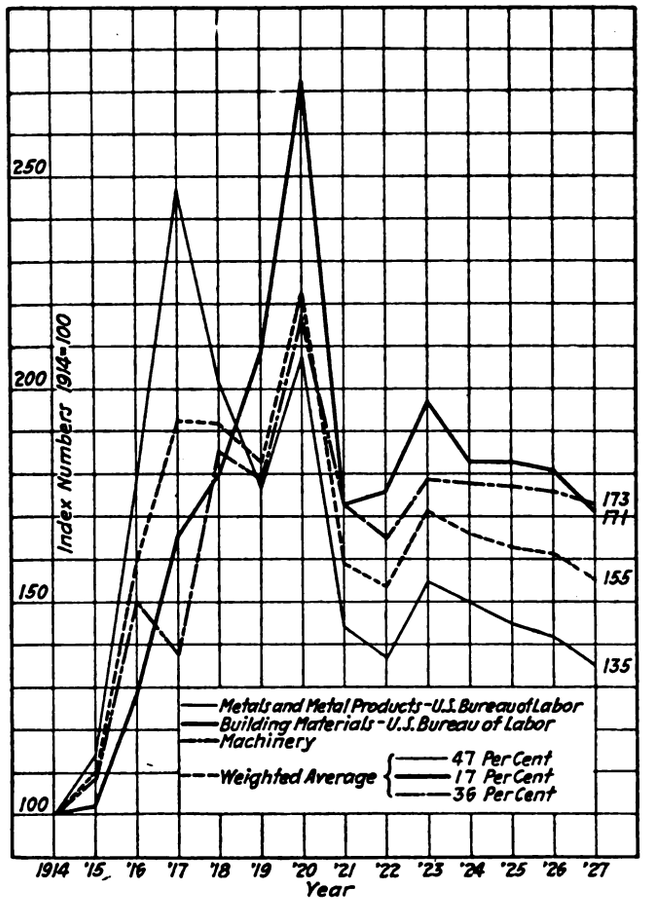


Fig. 1.—Index figures for wholesale material prices, 1914-1927

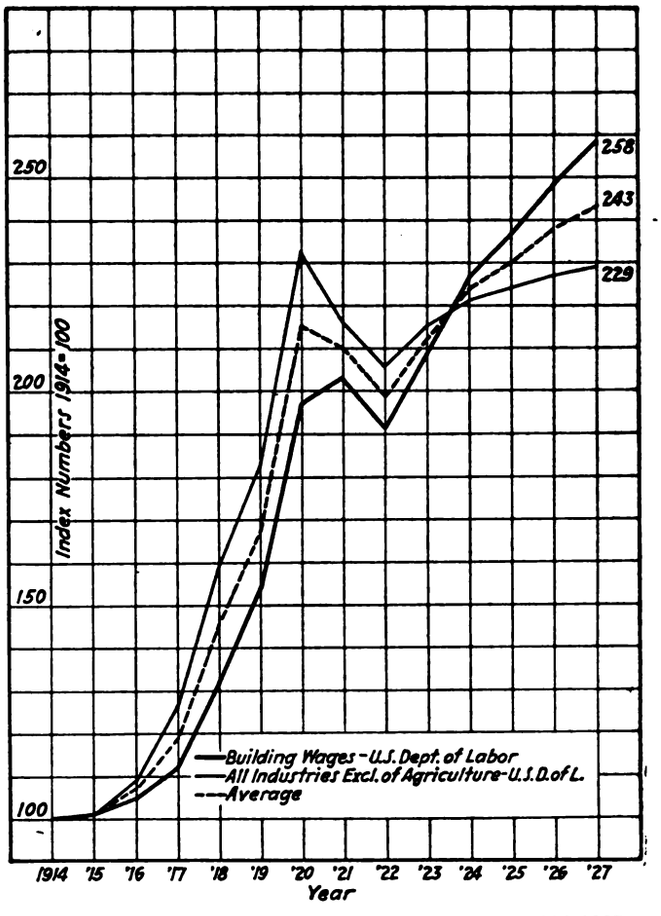


Fig. 2.—Index figures for hourly wage-rates, 1914-1927

Index figures of the Department of Labor for hourly wage-rates are recorded in Fig. 2. Three curves are plotted. The first gives the trend of hourly wage-rates for all reporting industries, exclusive of agriculture, for the years 1914-1927, and discloses the fact that these rates were 129 percent higher at the end of the period than at the beginning. The second curve covers hourly wage-rates of the building industry, and was selected as covering a number of the trades found in the shipyards. A very large increase in these rates is also recorded, the figure given for 1927 being 158 percent greater than that for 1914. A third curve has been

* Contributed by the National Council of American Shipbuilders, 50 Broadway, New York.



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plotted giving the average of these first two, and shows that the average increase in hourly wage-rates over the period amounted to 143 percent.

As of interest here, it should be stated that the average earned-rate per hour of the yard forces of one of the foremost yards in this country increased 146 percent from 1913 to 1928.

### Shipbuilding Costs Have Increased No Faster Than Costs of Material and Labor

In Fig. 3 two curves have been plotted. One shows the index figures for the cost or selling price of merchant ships built in the United States during the years

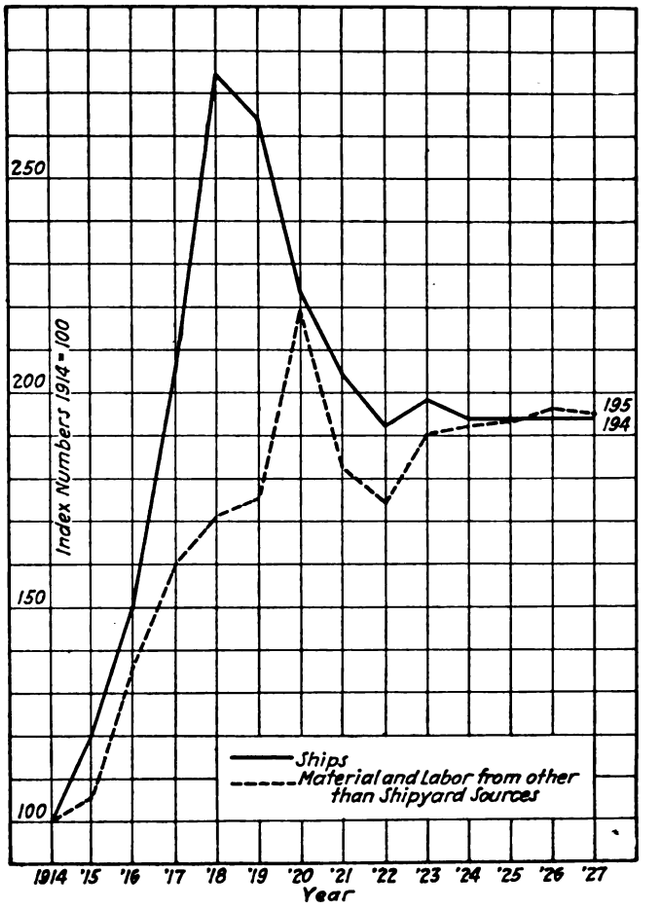


**Fig. 3.—Cost curves for ships and for material and labor from other than shipyard sources, 1914-1927**

noted, and has been copied from a similar curve on file with the Government at Washington. The other is a weighted curve, combining the average material and labor curves of Figs. 1 and 2. It has been assumed in plotting this second curve that in the year 1914 the elements of material and labor entered into the shipbuilders' cost in the proportion of 55 percent for material and 45 percent for labor. It is seen now from a glance at Fig. 3 that shipbuilding costs have not increased at a faster rate than have the general costs of materials and labor, although when one remembers the precarious condition of the shipbuilding business in 1914, with prices in some cases at cost, a very rapid rise in quotations would have seemed inevitable. A sharp peak in prices did occur during the war when ships were at a premium, but this prosperous period only served to tide the yards over until about 1922. Since then, shipbuilding has settled back into another slump, resulting in a blighting competition between the few plants that have managed to stay in business.

Applying these curves to shipbuilding costs on a dollar basis, the 1914 cost per dollar was $0.55 for material and $0.45 for labor. Material which cost $0.55 in 1914, had by 1927 increased in cost 55 percent or to $0.85. The 1914 labor cost of $0.45 in 1927 had increased 143 percent or to $1.09. The 1927 equivalent of the 1914 shipbuilding dollar is therefore the sum of these increased-cost figures; material $0.85 plus labor $1.09 make $1.94. Since the cost index of ships from Fig. 3 is 194, present selling prices are comparatively as low as they were in 1914.

### Why Rock-Bottom Prices Must Prevail

It is not difficult to explain or understand why the present situation exists or why rock-bottom prices must of necessity now prevail when we consider the following causes:

1. The Reduction in Armament Conference, which almost wholly suspended naval work, left the shipyards dependent upon commercial work.
2. The Government's recent policy of building new vessels in Navy Yards.
3. The existence of the vast war fleet of ships which the Government has been selling off as fast as the market could absorb them.
4. The admission to the coastwise trade, under Section 22 of the Merchant Marine Act of 1920, of 65 American-owned but foreign-built vessels, resulting in stagnation of new construction for coastwise service.
5. The low cost of building ships in foreign yards. Vessels can be purchased abroad for one-half the price that must be asked for similar vessels in this country.

Such facts as these have offered scant encouragement to any selling price greater than the bare cost to the shipbuilder. In spite of the precarious conditions of the industry and the knowledge that little or no profit is included in the price the shipbuilder gets for his product, it is to the shipbuilder's credit that the shipowner is receiving a much better ship for his money today than ever before. This country is now in a period of great engineering and scientific advancement to which the shipbuilding and marine engineering industry is contributing its share. While several veteran shipyards have in recent years been forced to close their doors and liquidate, it is a noteworthy fact that faulty design or poor workmanship was never a contributing cause. In spite of almost insurmountable handicaps, continuously better ships have been built. A remarkable development has taken place. Steam pressures have been increased; direct-drive turbines, geared turbines, Diesel engines, turbine-electric and Diesel-electric drives have been developed and perfected. Boilers, auxiliaries and energy-saving devices such as economizers, feed-water heaters, air preheaters, superheaters and high-vacuum apparatus have been applied and brought to a high state of development. The result has been greater fuel economy, higher speed, freedom from noise and vibration, greater safety and comfort, increased cargo space, greater ease in maneuvering and superior cargo-handling facilities.

### Higher Cost of Modern Machinery Justified by Economies Gained

Modern propelling machinery admittedly costs somewhat more than the older type of engine, but the extra cost in the majority of cases is fully justified by the economies and benefits gained. For example, take the following table which shows a comparison between certain items relating to high-pressure, geared-turbine propelling plants and low-pressure, reciprocating-engine

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installations. Four different sized units have been selected, varying in output from 2000 to 9200 shaft horsepower, and a comparison between the corresponding weights, fuel consumptions and costs installed on board ship have been made. The use of fuel oil under the boilers has been assumed in each case. The cost figures include the complete plant installed in the hull, and there have been added a normal shipyard overhead and 10 percent for profit.

COMPARISON OF MARINE PROPELLING MACHINERY

| | | | | |
|---|---|---|---|---|
| **High-Pressure, Geared-Turbine Ships** | | | | |
| S.H.P. in service | 2000 | 3650 | 5800 | 9200 |
| No. of shafts | 1 | 1 | 1 | 1 |
| Boiler pressure | 300 | 300 | 300 | 300 |
| Superheat | 200 | 200 | 200 | 200 |
| Lbs. oil fuel per S.H.P. | 0.90 | 0.89 | 0.875 | 0.86 |
| Oil fuel, tons per day | 19.26 | 34.76 | 54.30 | 84.66 |
| Weight of Machinery | | | | |
| Wet, tons | 325 | 545 | 800 | 1275 |
| Dry, tons | 310 | 515 | 760 | 1210 |
| Cost installed | $241,500 | $386,000 | $550,000 | $873,000 |
| **Low-Pressure, Reciprocating Engines and Scotch Boilers** | | | | |
| I.H.P. in service | 2200 | 4000 | 6400 | 10,000 |
| No. of shafts | 1 | 1 | 1 | 2 |
| Type Engine | Triple | Quad. | Quad. | Quad. |
| Boiler Pressure | 210 | 220 | 220 | 220 |
| Lbs. oil fuel per I.H.P. | 1.20 | 1.08 | 1.06 | 1.04 |
| Oil fuel, tons per day | 28.25 | 46.22 | 72.59 | 111.28 |
| Weight of Machinery | | | | |
| Wet, tons | 450 | 830 | 1300 | 2200 |
| Dry, tons | 395 | 725 | 1144 | 1950 |
| Cost, installed | $175,000 | $295,500 | $462,500 | $787,000 |

It will be noted that in this particular analysis a saving is shown as accruing to the modern propelling plant in the matter of weight of from 28 to 42 percent. This means that the shipowner can carry from 125 to 925 tons more cargo or build a smaller ship to carry the same cargo. Again, there is in each case a saving of oil per day for the particular plants as rated in the table. On a percentage basis this means a reduced fuel consumption of from 31 to 24 percent. To obtain these reduced fuel consumptions the cost of propelling machinery has increased from between $88 and $85 per shaft horsepower for the reciprocating-engine and Scotch boiler installation to between $121 and $95 per shaft horsepower for the geared-turbine or turbo-electric and watertube combination, a range of between 37 and 12 percent.

## Savings in Fuel Costs with Modern Machinery

As figures, these percentages are only comparative but when translated into dollars the increased economic value of the modern ship proves itself. The price of fuel oil for the next three years can be taken at $1.25 per barrel of 42 gallons at 7.9 pounds per gallon; 332 pounds for $1.25 or $.0038 per pound. The 2200 indicated-horsepower reciprocating engine with Scotch boilers would burn 2640 pounds of oil per hour, costing $10.04. The 2000 shaft-horsepower turbine with watertube boilers will burn 1800 pounds of oil per hour, costing $6.85, saving $3.19 per hour on the fuel cost of the reciprocating engine with Scotch boilers. The turbine installation will cost $66,500 more than the reciprocating engine, but saving $3.19 per hour will pay for the increased cost in 20,085 hours or 870 days, after which the saving of $3.19 per hour becomes a net reduction of $76.60 per day in fuel cost.

Similarly a 10,000 indicated-horsepower reciprocating engine with Scotch boilers would burn 10,400 pounds of oil per hour, costing $39.50. The equivalent 9200 shaft-horsepower turbine with watertube boilers would burn 7910 pounds of oil per hour, costing $30.00, saving $9.50 per hour on the fuel cost of the reciprocating engine with Scotch boilers. The turbine installation will cost $86,000 more than the reciprocating engine, but saving $9.50 per hour will pay for the increased cost in 9050 hours or 377 days, after which the saving of $9.50 per hour becomes a net reduction of $228 per day in fuel cost.

The power plant comparisons are shown graphically in the curves in Fig. 4.

From the standpoint of fuel consumption the American ship of 1928 is worth more to the owner and operator than the corresponding ship of 1914.

But if selling prices for ships are as low as can be hoped for under present-day conditions, what is the outlook for the future? It is to be expected that the price of a ship will, in normal times, increase approximately at the same rate as the cost of the labor and material entering into its construction, less such savings as may be made possible through the use of more modern

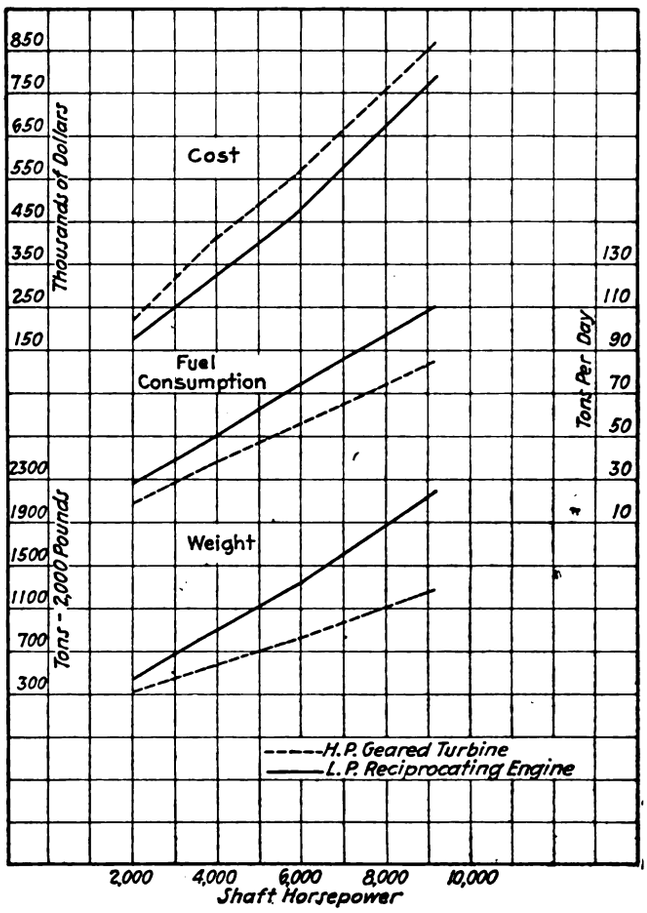


**Fig. 4.—Comparison of high-pressure geared-turbine and low-pressure reciprocating propelling machinery**

tools and methods. The task of the shipbuilder is, to a considerable extent, one of assembling, so that, to a large degree, his selling price is determined for him by the price he has to pay for materials, equipment and labor. Over these elements of cost the builder has little or no control. It is a case of supply and demand. If business should increase, some improvement can be made in the more efficient use of man power and plant facilities, and with more work in the yards, the overhead charges will have a wider spread. Maintenance of the highest efficiency in this industry is, as in many others, dependent upon volume of work, but volume has in recent years been lamentably lacking.

## Lower Prices Out of the Question Until Shipyards Have More Work

That there will be a reduction in the cost of ships built in the United States does not seem possible until such time as the shipowners give the yards sufficient business to put them upon a normal operating basis.

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When such a time shall come, the shipyards will further improve their efficiency, and the overhead charges will be distributed over many instead of a few contracts. There will then be some hope for a fair profit to the builder, to be followed by lower prices to the shipowner.

The recent enactment of the Jones-White bill and the passing of additional legislation favorable to shipping, which it is hoped will follow, permits the shipowner to operate his vessels at a lower cost and thus encourages the purchase by him of new and always more efficient tonnage. At present the shipyards are looking to the shipowners for sufficient work to enable them to continue in business, to receive a fair and reasonable price for their product, and eventually to reduce the cost of ships. The present selling prices of new vessels are not out of line and when the facts are considered it becomes clear that any reduction in these prices must wait upon the action of the buyers themselves.

# New Capital Ships

By Lieut. Comdr. G. C. Manning, (C.C.), U. S. N.

DURING the past winter, when the Navy Department's recommendations for new construction were the subject of considerable discussion, one phase of the subject upon which there was considerable diversity of opinion was the type of ship in which the Navy stands in greatest need. The Congress apparently felt that the Navy's greatest need was treaty cruisers. If the recommendations of the naval committees of the Senate and House of Representatives correctly mirror the convictions of the members of these committees, they feel that the Navy has urgent need for a few treaty cruisers, a minor deficiency in aircraft carriers (only one was recommended) and will require no other ships in the next five years—no submarines, no destroyers, no destroyer leaders, no battleships!

The author is of the opinion that such is not the sentiment of the majority of the people who comprise this nation. In the first place let us summarize the relative standing of the United States Navy in the various classes of men-of-war.

### Our First Line of Defense

In cruisers we are entirely outclassed both in number of ships and in their total displacement. Cruisers are therefore an urgent need.

Destroyers we have in large numbers, in larger numbers than any other naval power, but they are getting near the end of their useful life. They have passed their prime and are "going down hill." Most of them are from eight to ten years old and the effective life of a destroyer is usually considered not in excess of 15 years. It would be well to build a few ahead of time or we are likely to find our entire force going to pieces like the "one-hoss shay."

We have no destroyer leaders at all. This type of ship was of very material value during the World War.

In submarines we have a lot of *S*-boats, eight to ten years old, and a few *V*-boats, real fleet submarines. We shall be in the same condition regarding submarines as that outlined above for destroyers, if we do not build submarines faster than we have been doing during the past few years.

Of aircraft carriers we have but three. We do not have "all of our eggs in one basket," but we are not far from that unenviable position. Those that we have are admittedly experimental.

We should do something progressive in connection with enlarging our mobile flying force. Heavier-than-air craft seem reasonably well provided for in the existing program but of lighter-than-air craft we have only one large dirigible and that cannot be used for military purposes. We are certainly deficient in this type of naval weapon.

### New Capital Ships Our Greatest Need

We should be doing or plan to do something to replace or increase the number of our ships in each of these classes, but in the author's opinion our greatest need is new capital ships. *The capital ship is the backbone of the fleet.* It is the framework around which the various types of auxiliary craft are grouped. A fleet deficient in capital ships is like a tree with a rotten trunk. The auxiliary classes of ships are only the branches; the strength of the tree depends not upon them but upon the trunk.

One of the fundamental considerations upon which the Reduction of Armaments Treaty was based was that there should be equality between the United States and Great Britain in the matter of capital ships. That such equality does not, in fact, exist is well known by everyone who has given the matter more than passing consideration. The United States Navy has 18 battleships having a normal displacement of 525,850 tons. On the same basis of tonnage (which is different from both the British "legend" displacement and the treaty "standard" displacement) the 20 British battleships have a displacement of 583,108 tons, a difference of nearly 60,000 tons or two battleships.

### British Battleships More Homogeneous in Age and Size

But this is only part of the story. The average age of the ships comprising each of these forces is the same, 11.3 years, but in the British force there is no ship older than 14 years. There are two ships, the *Nelson* and *Rodney,* just completed, which are of greater displacement than any United States battleship, and the *Hood,* only eight years old, the largest man-of-war in the world. The other 17 ships are all between 11 and 14 years old. Of the United States battleships, the newest, the *Colorado and West Virginia,* are five years old. We have two ships which are 17 years of age, two that are "sweet" sixteen. The others are sprinkled between the ages of 14 and 5 years in a fairly uniform distribution.

The displacement of the British battleships varies from 25,000 tons to 27,500 tons legend displacement, except for the *Rodney* and *Nelson,* which are 35,000 tons standard displacement. The legend displacement of the British ships is 4 percent less than what the normal displacement would be according to methods of computation used in the United States Navy. The standard displacement is 6.6 percent less. Of the battle cruisers, two are of 26,500 tons, one of 28,500 tons and one of 41,200 tons. The United States has no battle cruisers at all. The normal displacement of our battleships varies from 21,825 tons to 32,600 tons. These are displacements when the treaty was signed;

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they may be increased by not more than 3,000 tons by "modernization," subject to certain limitations in the treaty, and this has already been done in the case of several ships.

The point of these remarks is that the British battleship force is much more homogeneous in age and displacement than the United States battleship force, and this homogeneity is in an element of increased strength. In only one particular is the United States battleship force more homogeneous than the British, and that is speed. The speed of all of our battleships is 21 knots, which is equal to that of the slowest British battleships! Great Britain has four 21-knot battleships, seven 23-knot battleships, five 25-knot battleships and four battle cruisers having speeds between 28 and 32 knots.

### Striking Power of British Ships Superior

In the power of the main batteries the British battleships are superior to those of the United States Navy. We have four ships with 12-inch guns, eleven with 14-inch guns and three with 16-inch guns. The smallest gun in the main battery of the British battleship force is the 13.5-inch gun, a weapon which compares with our 14-inch gun. There are five British ships having this size gun, thirteen having 15-inch guns and two having 16-inch guns. The United States has six ships having a maximum range of only 21,000 yards and two others having 21,600 yards. The least maximum range of any British capital ship is 23.800 yards, an advantage of over 2,000 yards.

*The only way that the United States can bring its battleship force to an equality with that of Great Britain is by building new capital ships in accordance with the provisions of the Reduction of Armaments Treaty.* And the time is close at hand when the first new battleships, numbers 55 and 56, should be started.

### Modernization of Existing Ships Limited by Treaty

It may be urged that, by modernizing our capital ships in accordance with the provisions of the treaty, the United States may overcome the inferiority of our battleship force. The portion of the treaty bearing on the modernization of capital ships states:

> No retained capital ships or aircraft carriers shall be reconstructed except for the purpose of providing means of defense against air and submarine attack, and subject to the following rules: The Contracting Powers may, for that purpose, equip existing tonnage with bulge or blister or anti-air attack deck protection, providing the increase of displacement thus effected does not exceed 3,000 tons (3,048 metric tons) displacement for each ship. No alterations in side armor, in caliber, number or general type of mounting of main armament shall be permitted except: (1) in the case of France and Italy, which countries within the limits allowed for bulge may increase their armor protection and the caliber of the guns now carried on their existing capital ships so as not to exceed 16 inches (406 millimeters) and (2) the British Empire shall be permitted to complete, in the case of the *Renown*, the alterations to armor that have already been commenced but temporarily suspended.

There has been a great deal of controversy regarding whether this provision of the treaty authorized increasing the elevation of the main battery guns. The author holds that such increased elevation is not permitted. If the provision quoted above means anything, it means that the Contracting Powers may alter existing tonnage only for the purpose of increasing the protection against attack by aircraft and submarines. The treaty does not even leave each Power unlimited scope to increase the defensive powers of existing tonnage but sets certain limitations on the work to be done. No one can contend that alterations to permit greater elevation for the main battery guns is a measure to increase the ship's powers of defense against aircraft or submarines. Therefore the author feels that increasing the elevation of the main battery guns of the existing United States battleships is not permissible under the treaty.

But even if it were permitted, and were accomplished, the inferiority in gun power of the United States battleships would not be overcome. Increasing the angle of elevation will not make a 12-inch shell deliver the punch of a 16-inch shell. Comparisons of diameter are liable to be misleading because, given equal striking velocities, *the striking energy of a projectile varies as the cube of the bore.* The inferiority of a 12-inch shell to a 16-inch shell is not in the ratio of four to three but of sixty-four to twenty-seven. *A 16-inch shell is more than twice as effective as a 12-inch shell.*

### United States Must Build New Capital Ships to Overcome Britain's Lead

In accordance with the provisions of the Reduction of Armaments Treaty, the United States may lay the keels of two new capital ships of 35,000 tons standard displacement on or after November 12, 1931, and these new capital ships may be commissioned on or after November 12, 1934. If these ships are commissioned November 12, 1934, the scrapping of the *Florida, Utah* and *Wyoming* must start on the same date, and these ships must be rendered incapable of war-like service within six months of this date and be entirely destroyed within a period of eighteen months of the completion of the new ships. The treaty, therefore, allows thirty-six months to complete a ship after the laying of the keel. This is slightly less than the average time of construction for existing United States battleships.

Based on actual experience, a shipyard cannot lay the keel of a large ship in less than about six months after the award of the contract. Existing statutes require that prospective bidders on naval construction be allowed sixty days in which to prepare their bids. The very latest date, then, at which the Congress should authorize and appropriate for these new capital ships is the short session from December, 1930, to March, 1931.

But why wait until the last minute? It frequently happens that many important bills are caught in a jam and fail of enactment in the short sessions of the Congress. There is only one regular long session of the Congress between now and March, 1931. The sooner the Congress authorizes and appropriates for two new capital ships to be built in accordance with the treaty the better. We shall then have started action, which, if consistently followed, will bring this nation to equality in capital ships with Great Britain and the provisions of the Reduction of Armaments Treaty will have been fulfilled.

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AMERICAN SEAMEN.—The work being done by the Shipping Board's Sea Service Section toward the Americanization of crews on its vessels is shown in figures just compiled for the past fiscal year. A total of 59,530 seamen, were placed during the year, 89 percent of which were American citizens, either native born or naturalized, as compared with only 10 percent in 1917.

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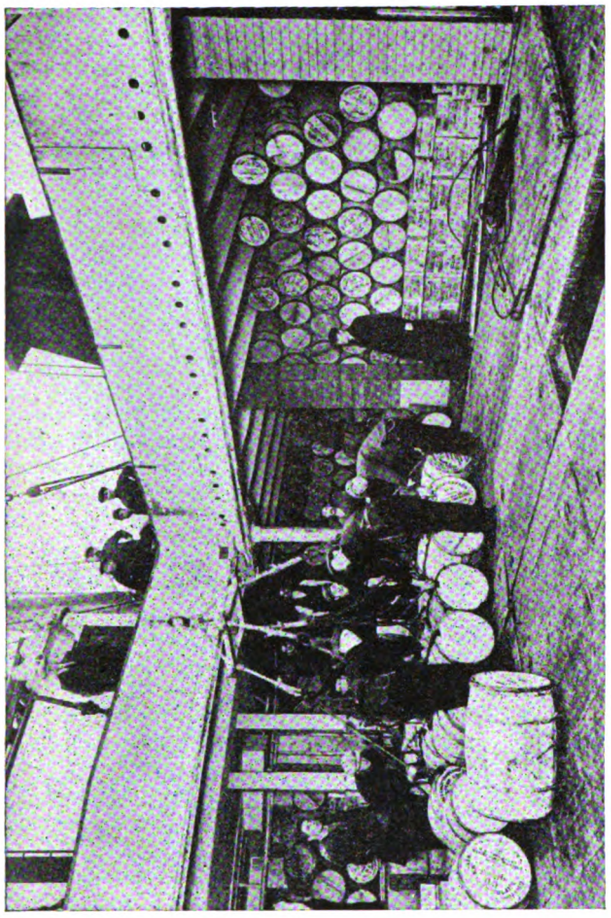
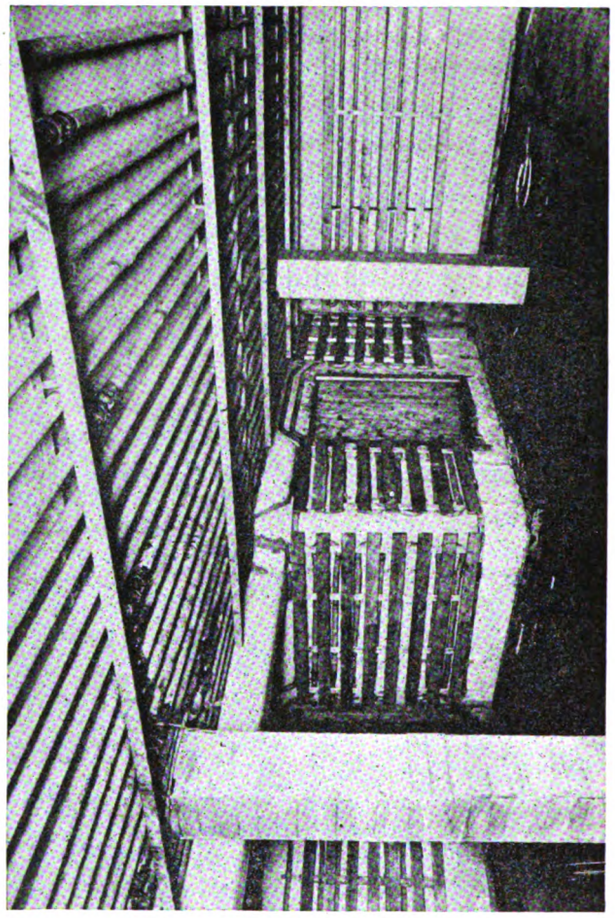
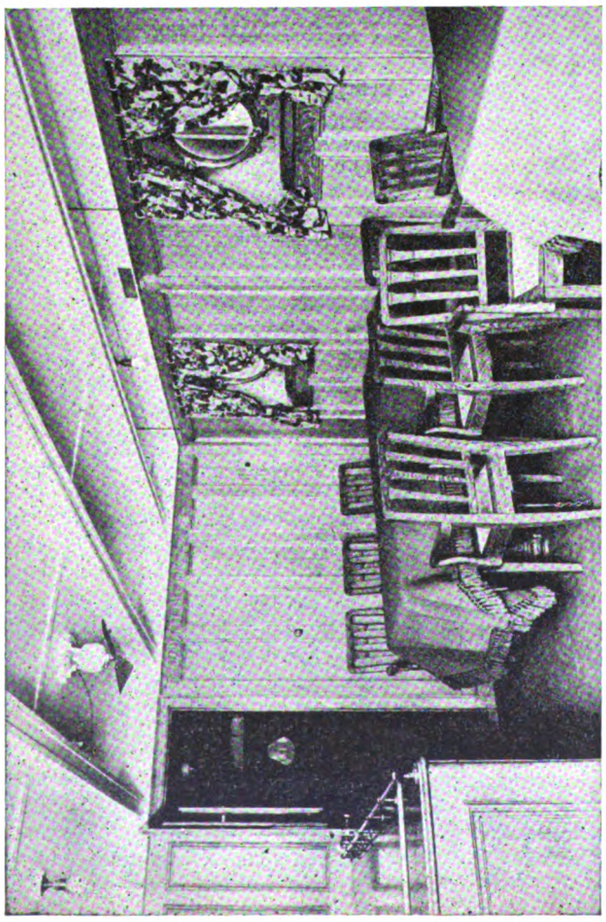


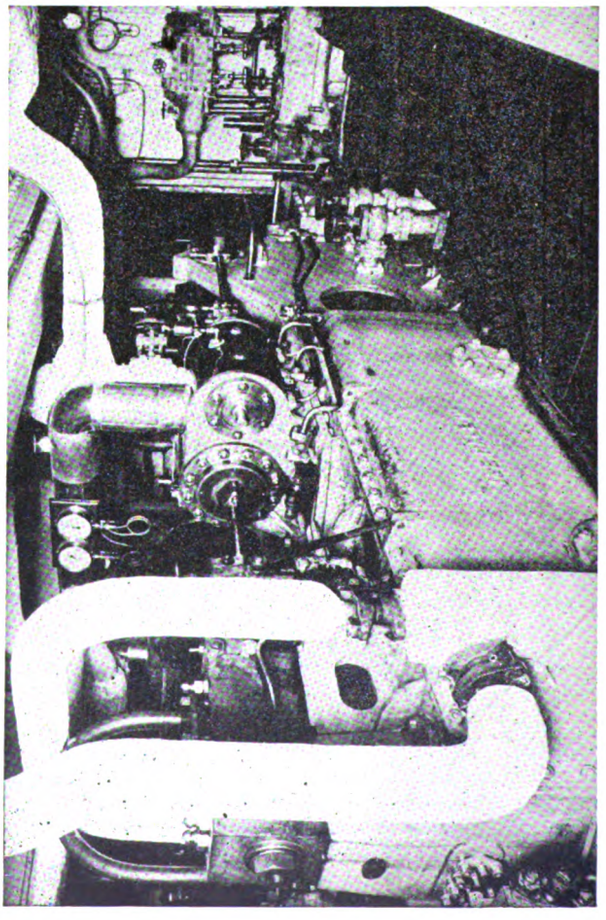
Unloading cargo



Meat cold chamber



Officers dining room



Refrigerating plant

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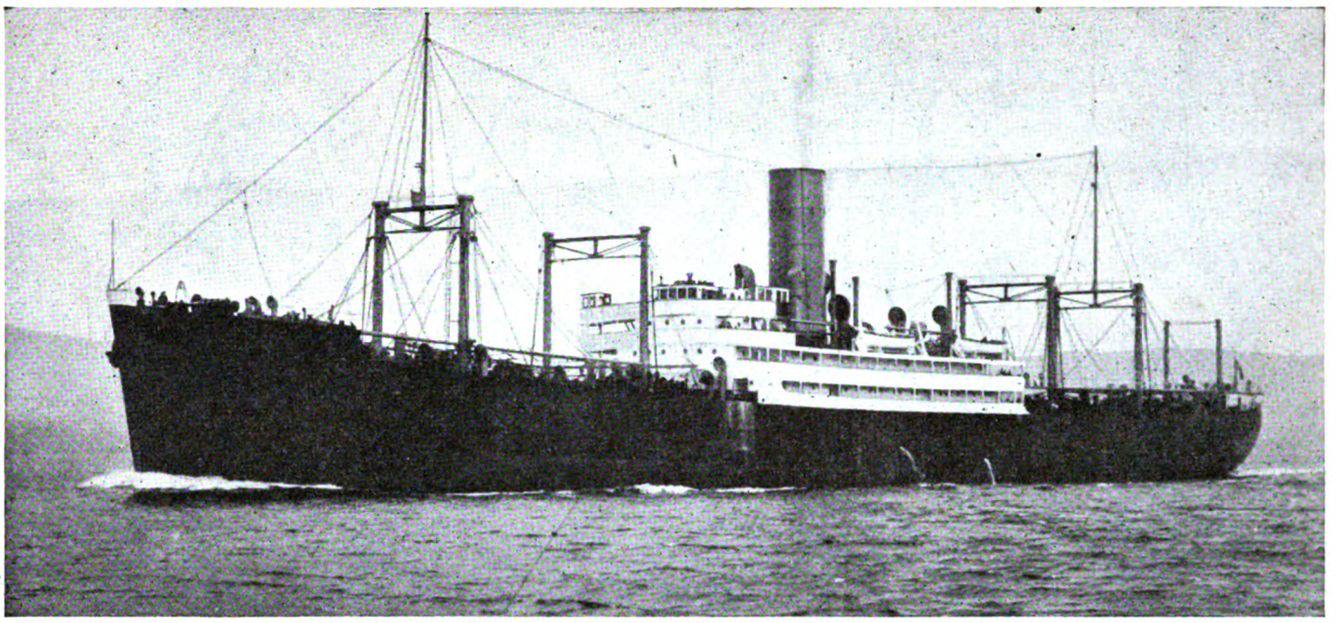

Canadian Pacific steamship Beaverburn

# New Canadian Pacific Cargo Ships

## Five freighters of the "Beaver" class, built for economy of operation, now in service

THE Canadian Pacific Steamships, Ltd., Montreal, Canada, is now operating five modern, twin-screw vessels which were delivered during the past year. These ships are known as the "Beaver" class and are employed in transatlantic cargo service. The new vessels were built at three yards as follows: The *Beaverburn* was built by William Denny & Bros., Ltd., Dumbarton, Scotland; the *Beaverford* and the *Beaverhill* were built by Barclay, Curle & Company, Ltd., Glasgow, Scotland; while the *Beaverbrae* and *Beaverdale* were built by Sir W. G. Armstrong, Whitworth & Company, Ltd., Newcastle-on-Tyne.

All five vessels are of practically the same design. Opportunity is, however, taken to compare the relative advantages of hand firing and mechanical stoking. The *Beaverburn, Beaverford* and *Beaverhill* are equipped with mechanical stokers while the *Beaverbrae* and *Beaverdale* are hand-fired.

### Main Particulars

The following descriptions of this class of vessel refer to the *Beaverburn,* the principal particulars of which are as follows:

| | |
|---|---|
| Length on waterline | 512 feet |
| Length between perpendiculars | 503 feet |
| Breadth, molded | 61 feet 6 inches |
| Depth, molded | 40 feet 6 inches |
| Deadweight capacity, about | 13,000 tons |
| Load draft | 30 feet |
| Gross tonnage | 9876 tons |
| Underdeck tonnage | 9095 tons |
| Net tonnage | 5931 tons |
| Cargo capacity | 570,000 cubic feet |
| Insulated hold capacity | 80,000 cubic feet |
| Service speed | 14 knots |

The vessel has been built to the highest class of Lloyd's Register and is provided with two decks and a 'tween deck in all the holds except No. 6. She is strengthened forward for navigation in ice and is provided with a raked stem and a cruiser stern.

### General Arrangement

The accomodations for officers and crew are located amidships. Deck officers and engineers are accommodated on the bridge deck in cabins which are comfortably furnished, well ventilated and well lighted. The seamen and firemen are berthed in small cabins on the upper deck.

A large proportion of the hold and under deck capacity is insulated for the carriage of frozen and chilled produce. The refrigerating plant was supplied by J. & E. Hall, Ltd., Dartford. A special fume-tight cargo space, designed for the carriage of essential oils is also provided. The insulation of the cargo holds and the steam pipes has been carried out by Newall's Insulation Company, Ltd., Newcastle-on-Tyne.

The vessel is provided with a duct keel which runs from the forward end of the boiler room into the forward hold. The various bilge and ballast pipes run along the duct keel. This arrangement allows greater accessibility and reduces the cost of maintenance.

### Cargo-Handling Arrangements

The cargo-handling arrangements are most complete in character. Substantial twin derrick posts are provided, each set having strong cross-bracing with a centralized mast extension. The disposition of the remaining twin derrick posts is shown on the profile and upper deck plan. In all, 27 tubular steel derricks are provided, one of these being designed to handle loads



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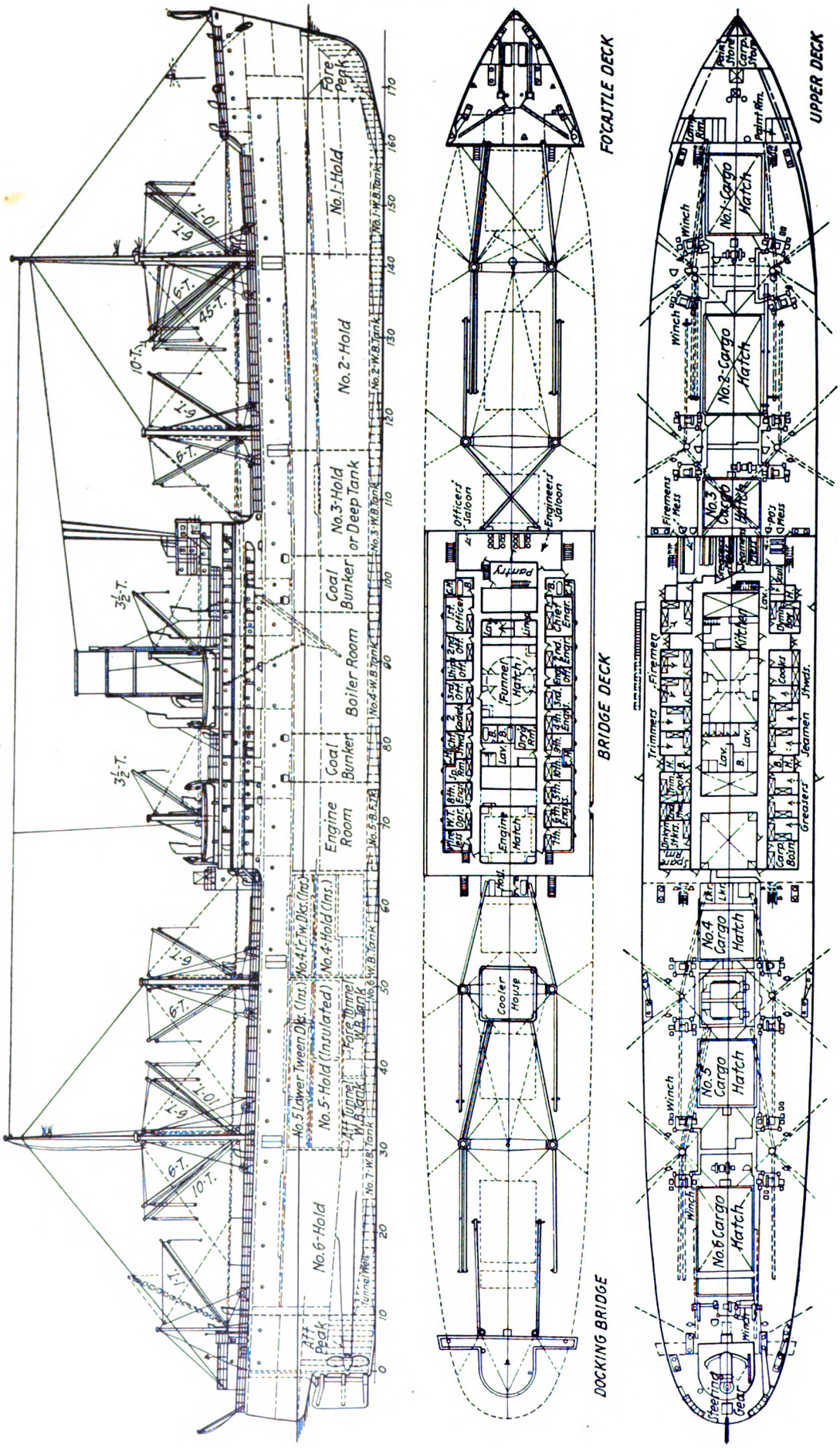


General arrangement plans of Canadian Pacific cargo steamship Beaverburn

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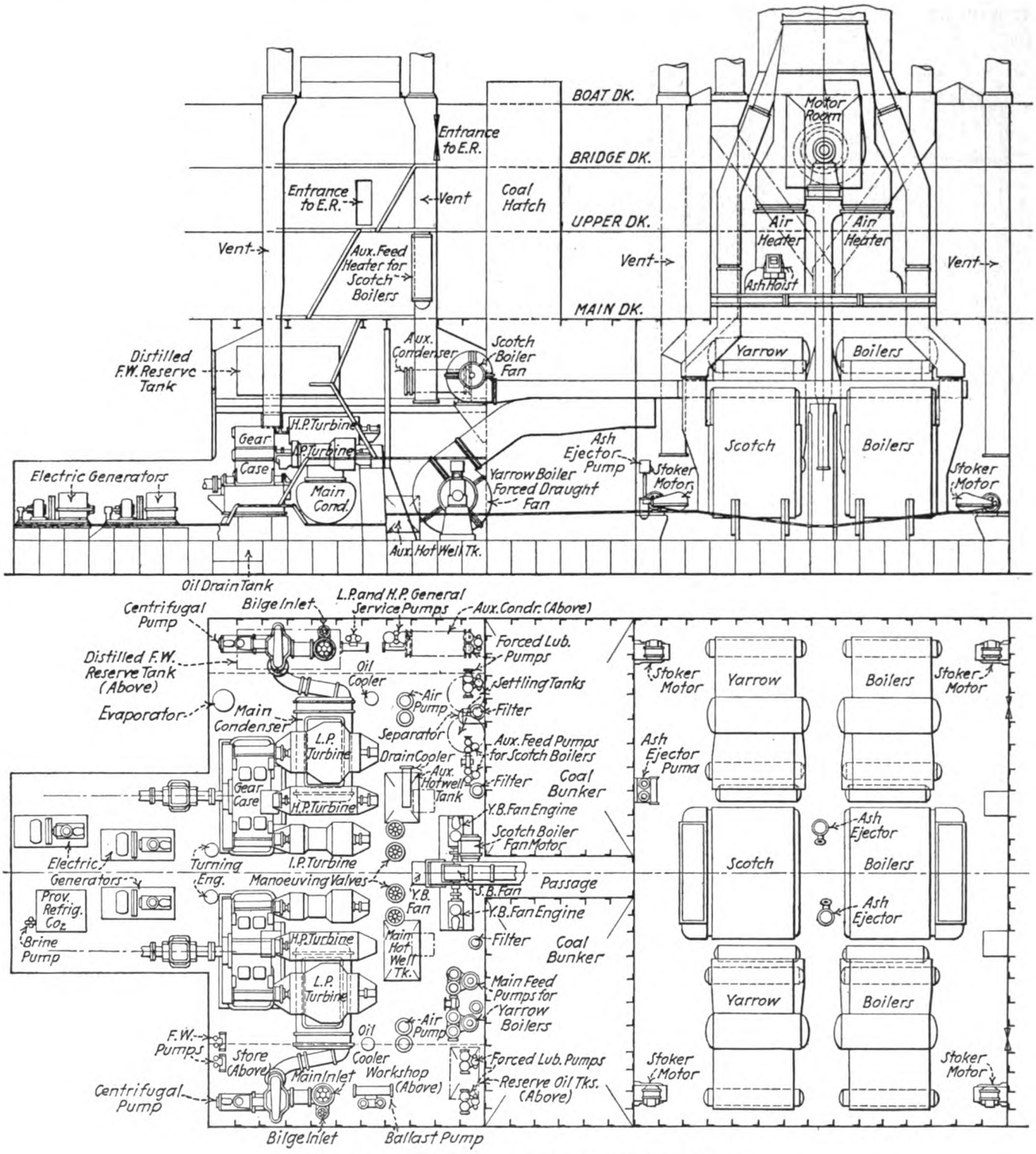
up to 45 tons; 17 steam winches, supplied by John Lynn & Company, Ltd., Sunderland, serve these derricks. A steam-driven windlass, located on the forecastle deck, was made by Clarke, Chapman & Company. The telemotor controlled steering gear is made by Brown Bros. The boat davits are of the Columbus type supplied by Samuel Taylor & Sons, Ltd.

### Propelling Machinery

The propelling machinery of the *Beaverburn* consists of two sets of Parsons type single-reduction geared-turbines supplied by William Denny & Bros., Ltd. The total power of the installation is 7350 shaft horsepower at a propeller speed of 110 revolutions per minute. On trial, 8000 shaft horsepower was developed. The turbines are of the triple-expansion type, the high-pressure, intermediate-pressure and low-pressure casings being grouped around the common main gear wheel. Each turbine has its own pinion. All three pinions are placed around the upper half of the main gear wheel with the high-pressure pinion uppermost on the vertical centerline of the shafting.

The turbines are all of the pure reaction type. In the high-pressure casing monel metal blading of the




**General arrangement of engine and boiler rooms**

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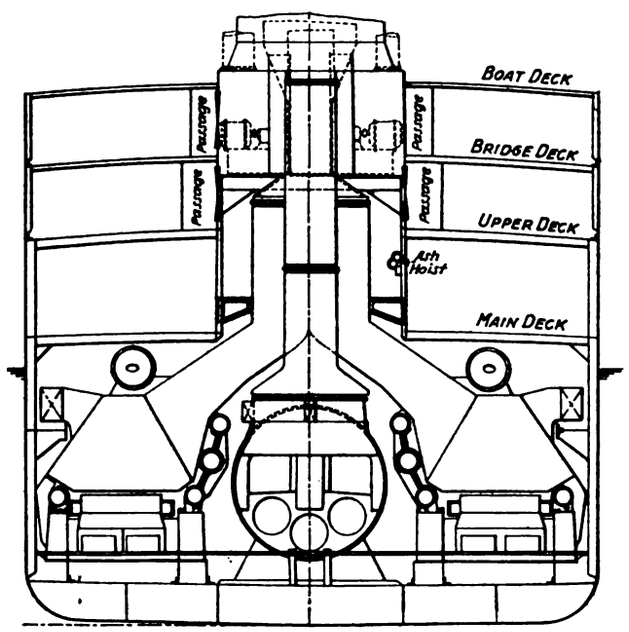
Parsons patent end-tightening type is used, but in the intermediate-pressure and low-pressure ahead turbines ordinary brass-mixture blading is employed. The high-pressure astern turbine, which is of the impulse type, is incorporated in the same casing as is the intermediate ahead turbine, while the low-pressure ahead stator also contains the low-pressure astern element.

A Weir regenerative type condenser is located on the under side of each low-pressure turbine. A circulating pump is located in either wing of the engine room. They are driven by totally-enclosed high-speed steam engines supplied by Drysdale & Company, Ltd., Yoker. The boiler feed pumps are of the Weir independent type while the automatic feedwater regulators




**Section through after boiler room, looking forward, showing arrangement of boilers and uptakes**

on the watertube boilers have been supplied by A. G. Mumford, Ltd., of Colchester.

The engine room auxiliaries in most cases are steam-driven. A Drysdale auxiliary steam engine is used for driving the three 50-kilowatt generator sets which are made by Laurence Scott. These are located in the thrust recess. This engine also drives two main circulating pumps and the forced-draft fans for the Yarrow boilers.

Four forced-lubrication pumps for the main machinery were supplied by G. & J. Weir, Ltd., Cathcart, and are placed close to the vertical engine-room bulkhead, two on the port side and two on the starboard side. In the lubrication system, the oil is forced from two Serck oil coolers which are arranged vertically in the vicinity of the water box on either condenser. After circulating through the various bearings and gearing sprayers, the oil passes to the drain tanks beneath the gear cases and from thence is re-circulated through the coolers by the pumps.

## Boilers

The steam plant comprises four Yarrow watertube boilers, built by William Denny & Bros., Dumbarton. These are supplied with integral superheaters, multitubular air heaters and Erith-Rowe mechanical stokers. Two hand-fired Scotch boilers are also installed. The superheaters for the watertube boilers are of the Yarrow type in which U-tubes are expanded into a circular drum at the lower ends. The tubes are self-draining and practically self-supporting. The two single-ended three-furnace Scotch boilers supply the steam to the various auxiliaries. Only one of the Scotch boilers is supplied with superheaters. The Scotch boilers supply steam to the deck machinery, generator set, etc., when the vessel is in port, although, in cases of emergency, one of the Yarrow boilers may be called into commission for this duty. An attemporator is fitted to the Yarrow boiler whereby the superheated steam may be reconverted into saturated steam. This is effected by leading the steam from the integral superheater of this boiler along the pipe which passes through the water in the steam drum. Separate feed systems are employed for each of the boilers with the object of excluding dirt, oil and scale-forming salts in the watertube boilers.

Feed-water losses in both systems are met by pumping tank water into the Scotch boilers. A connection is provided to the watertube boilers and Scotch boilers. In this way pure make-up feed is insured for the watertube boilers.

The four watertube boilers each have a generating surface of 3155 square feet, superheating surface of 775 square feet, and air-heating surface of 3088 square feet. The volume of the combustion chamber is 760 cubic feet, steam pressure 250 pounds per square inch, and the steam temperature at the boilers 650 degrees Fahrenheit. The guaranteed output from the four boilers is 64,000 pounds per hour, with a feed temperature of 200 degrees Fahrenheit. The guaranteed boiler efficiency of this output was not less than 80 percent, which figure was exceeded on the *Beaverford*.

It will be seen from the layout of the boiler installation that each Scotch boiler is placed between each pair of Yarrow boilers. The gases from the Yarrow boilers are led up from the inboard side of each boiler through the air heaters into a common funnel. On the outlet side of the watertube boilers two separate banks of tubes are arranged with the superheater between them. On the other side there is a bank of tubes which absorbs heat from the direct radiation of the furnace. The air for combustion is obtained from a fan placed in the engine room, the air being forced along the back of the boiler through the air heater down the side of the boiler into the stoker. A considerable amount of heat is absorbed by the air in circulating around the boiler. This arrangement has the effect of keeping the stokehold cool. In addition to the forced-draft fan, an induced draft fan is fitted which may be used as necessary.

## Mechanical-Stoking System

The Erith-Rowe mechanical stokers have been supplied by the Erith Engineering Company, Ltd., Erith, Kent. They are of the multiple-retort type. This is a new type of stoker for marine use. The stoker takes the form of a series of moving grates arranged side by side across the full width of the furnace. In the stokers fitted to the *Beaverburn* six such moving grates or retorts are provided. The coal is fed by hand into a hopper at the front end of the boiler. A series of rams pushes the coal forward on to the stationary retorts, these rams being actuated by a crankshaft driven by a Laurence Scott electric motor through a chain drive. Each unit of the moving coal pusher advances the fuel down the movable stepped hollow slicing bars between the retorts, simultaneously distributing it outwards. The coal pusher, slicing bars and extension grate are all

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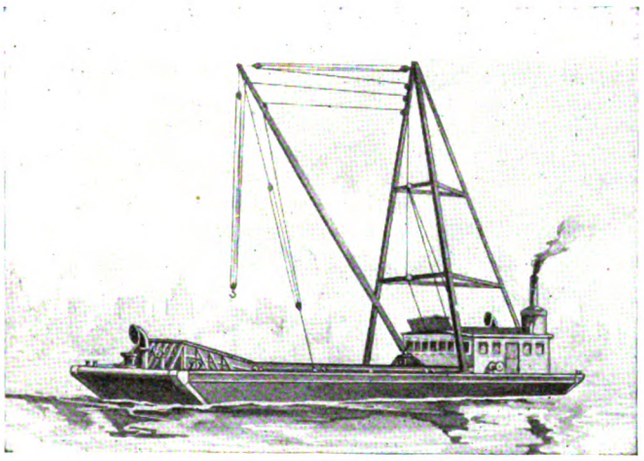
driven off the crosshead pin of the coal ram, the whole producing a simple stoker wherein a desirable degree of combustion control may be effected. From the extension grate the ash passes into an ash hopper at the back of the boiler.

The construction of these five vessels has been supervised by A. T. Wall & Company, naval architects, Liverpool; Mr. J. Johnson, the chief superintending engineer of Canadian Pacific Steamships, Ltd., and Mr. H. R. Macdonald, the company's naval architect.

## Ellis Channel Barge for Use in Porto Rico

A COMBINATION lighter, oil barge and molasses barge has recently been completed for the Porto Rico Coal Company of Porto Rico. This barge, employing the Ellis channel system of hull construction,



**New barge for the Porto Rico Coal Company**

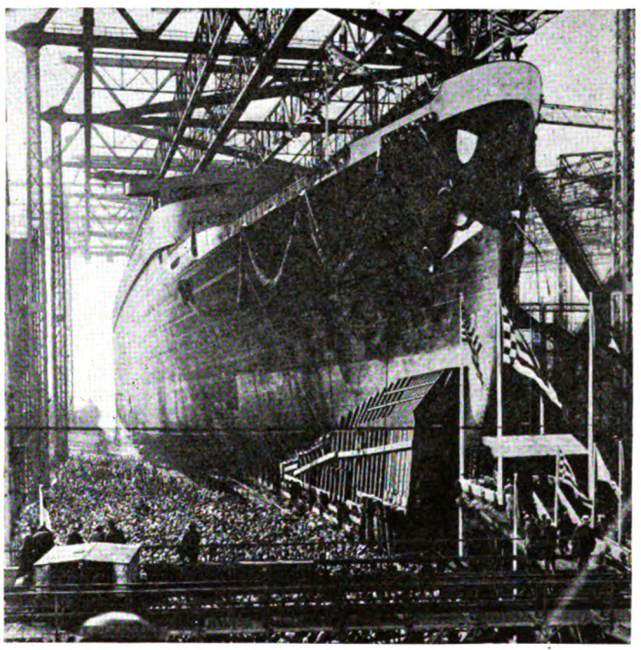
is equipped with a derrick having a capacity of 25 tons at a radius of 40 feet.

The over all dimensions are, length 120 feet, breadth 38 feet, and depth 10 feet. The hull is divided into eight tanks. Six compartments will carry oil. The two midship compartments will be used for carrying molasses. The capacity of the oil tanks is 192,000 gallons and of the molasses tanks 128,000 gallons.

Oil or molasses is discharged at stations or vessels alongside by means of a discharge line rising through the deck from the pump room back of the after bulkhead. At the forward end of the deck is a receiving pipe through which oil or molasses can be passed to the tanks. Deck cargo, therefore, can be carried and handled without interfering in any way with the carrying and handling of the tank cargo and vice versa. The capacity for deck load is about 550 tons.

## German Liner Europa

BELOW are shown views of the North German Lloyd Liner *Europa*, immediately before and after the vessel was launched last month at the Blohm & Voss shipyard, Hamburg, Germany. The sister ship *Bremen* was launched at about the same time.



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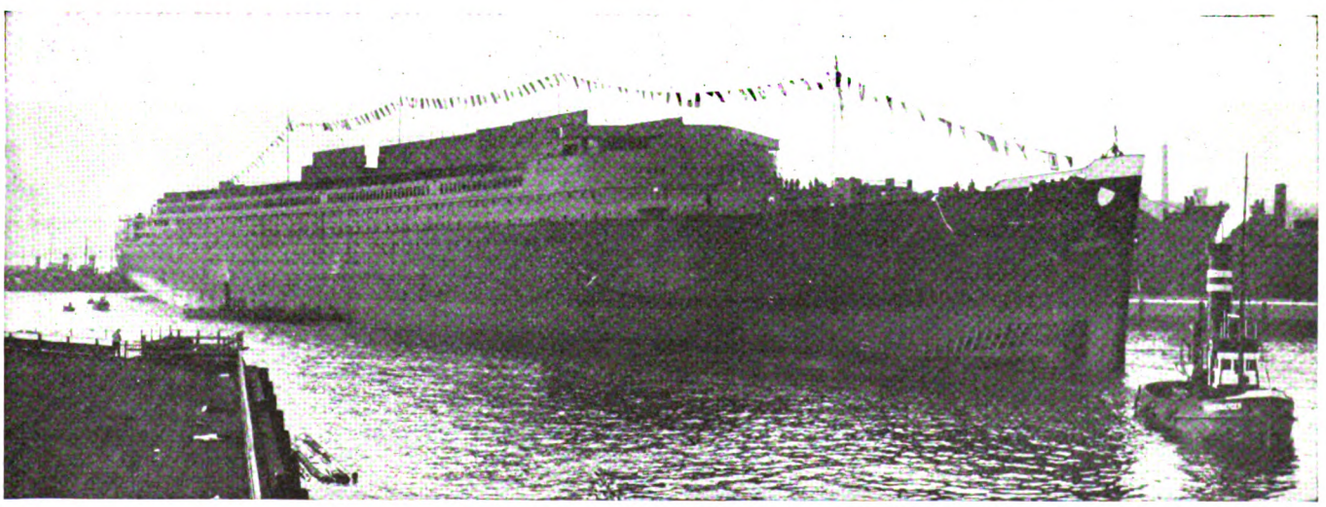
**North German Lloyd liner Europa ready for launching at the Blohm & Voss shipyard, Hamburg, Germany**



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**View of the North German Lloyd liner Europa just after launching**

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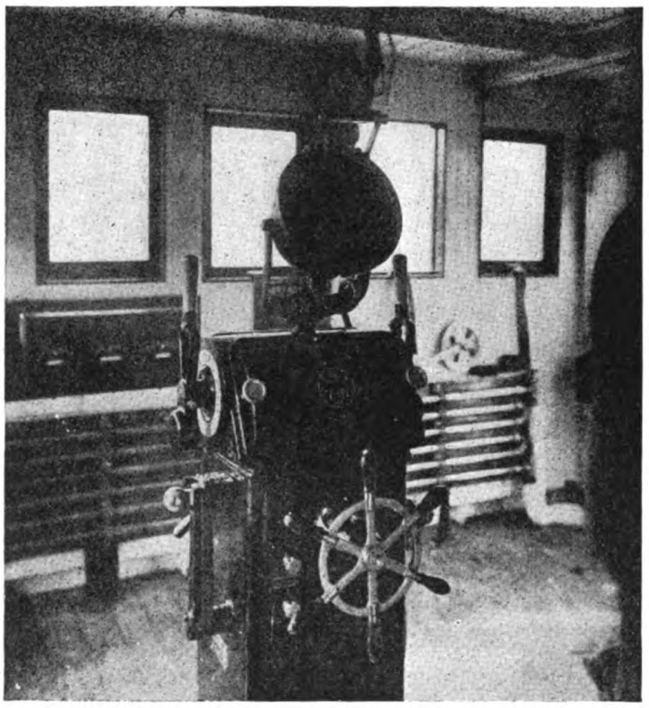
# Diesel-Electric Tanker Brunswick

## British-built American-owned tanker equipped with Ingersoll-Rand Diesel engines

By Our London Correspondent

IN the British marine engineering and shipbuilding world, all eyes have recently been turned toward the tanker *Brunswick*, chiefly on account of the fact that she is electrically propelled, the power being supplied from oil-engine-driven generators in the engine room. Until quite recently, British shipowners, and most engineers and shipbuilders, have been inclined to look on elec-



**Steering pillar showing the levers to left and right, which wholly control the machinery**

tric propulsion as something of a very doubtful proposition. When, however, the order was placed for this big tanker, and when, later, one of the most conservative of British shipowners, Lord Inchcape, fixed a contract for a 20,000-ton P. & O. liner to be electrically propelled (but using steam turbines instead of Diesel machinery) attention began to be concentrated on the possibility of electric propulsion. Lord Kylsant has recently commented, on more than one occasion, on electrically-propelled liners, and there is thus a possibility of further developments in England of a system that undoubtedly has its real origin in America.

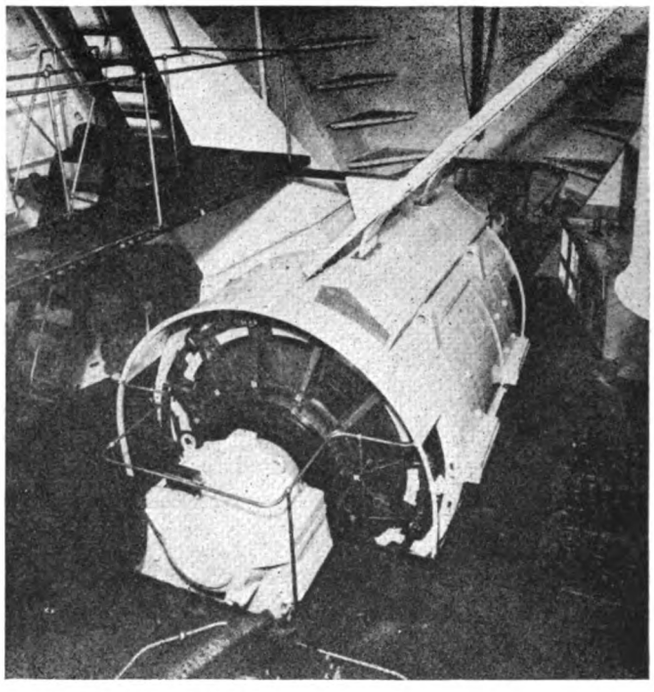
### Largest Diesel-Electric Merchant Ship

The *Brunswick* is reputed to be the biggest merchant ship equipped with a Diesel-electric system of propulsion and is the largest of the nine electrically-driven tankers which the owners, the Atlantic Refining Company, now have in service. At least they give very definite proof of their conviction that this class of vessel represents for them the most efficient that is available.

The following are the leading details of the *Brunswick*:

| | |
|---|---|
| Length | 469 feet |
| Beam | 63 feet |
| Depth | 33 feet 9 inches |
| Tonnage | 9,200 |
| Deadweight capacity | 12,500 |
| Brake horsepower | 2,800 |
| Service speed | 11 knots |

The *Brunswick* is interesting not only from the standpoint of propulsion but there are certain other features in her construction which are noteworthy. For instance, the cargo pumps are electrically-driven, a system which is finding favor to some extent among Scandinavian owners but is very seldom seen in British vessels. In the second place, in order to increase the efficiency of the vessel, an exhaust-heat boiler is installed, through which the exhaust gases from two of the engines driving the dynamos are passed. No doubt this boiler, which raises steam at 25 pounds per square inch, will supply the needs of the vessel so far as steam is concerned, while



**2800-brake-horsepower propelling motor**

she is at sea, so that the relatively uneconomical oil-fired boiler will not be needed except in harbor.

### Engines Built in Belgium

Another fact of interest with regard to the machinery of the *Brunswick* is that the Diesel engines installed represent the first European-built Ingersoll-Rand units. They were constructed at Ghent at the rebuilt Carels works, where Doctor Diesel disposed of some of his earlier licences for the manufacture of his engine shortly after its invention. The order for the *Brunswick* was, therefore, something of a mixed contract, for Scotts built



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**The Diesel-electric tanker Brunswick**

the hull on the Clyde, Carels constructed the American-designed Ingersoll-Rand engines, and the British Thomson Houston Company of Rugby was responsible for the whole of the electrical machinery.

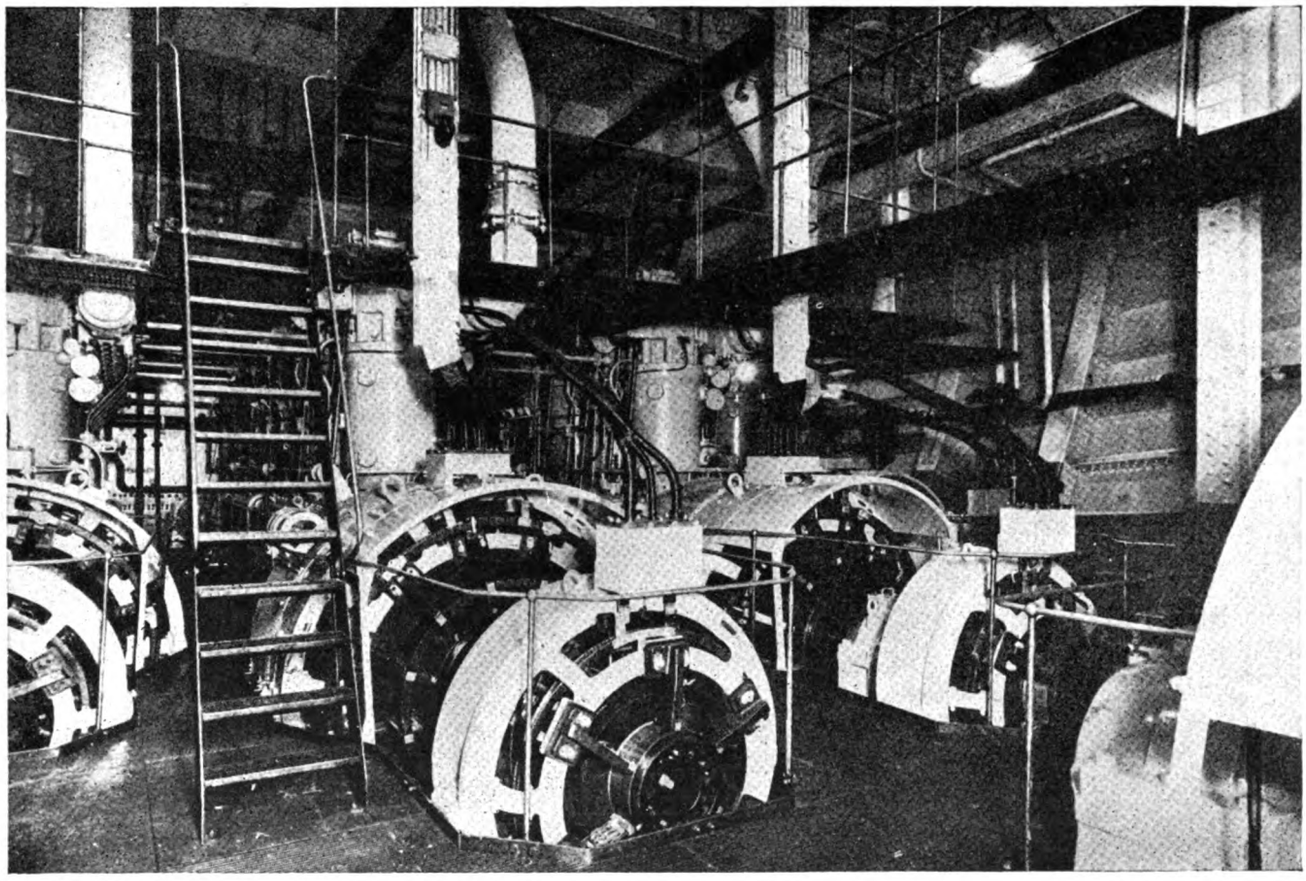
There are four engines, each of 750 brake horsepower with six cylinders, driving 600-kilowatt generators, in addition to a 75-kilowatt generator on the same shaft, the purpose of which is to supply power to the auxiliary plant, also to deliver current to the field of the generators.

In order to control the speed of the 2800-brake-horsepower motor coupled to the propeller, the voltage on the armature is gradually increased by rheostats, varying the fields of the generators at the same time, and all controlled from a single master lever. For this purpose, the generators are arranged in series so that the voltage variation is anything between zero and 1000.

In England, a great deal has been made of the fact that the *Brunswick* can be wholly controlled from the bridge, where electric cables are led, so that speed variation and reversal of the main propelling motor can be effected from this point. Such an arrangement has never previously been fitted on any British-built ship and it is probably true to say that the *Brunswick* is by far the biggest vessel in the world which can be operated wholly by the helmsman without the intervention of the engineer.

## Towboat for Alabama Service

THE Tennessee Coal, Iron & Railroad Company of Birmingham, Ala., has recently ordered a second Diesel-electric towboat for operation between Birmingport, Ala., and Mobile, Ala. The hull work of this boat is being carried out by the American Bridge



**Three of the Diesel-generating units in the Brunswick**

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Company, Ambridge, Pa., and the machinery installation and outfitting will be done by the Carnegie Steel Company, Pittsburgh, Pa.

This towboat, which is a duplicate of the first, will have a length of 140 feet, a breadth of 25 feet and a depth of 9 feet 3 inches. The boat will be of the twin-screw, tunnel-stern type.

The Diesel-electric installation will consist of two 550-brake horsepower Nelseco Diesel engines built by the New London Ship & Engine Company, Groton, Conn., and will be direct-connected to two General Electric, 335-kilowatt, 250-volt, direct-current generators operating at a speed of 250 revolutions per minute. Each propeller will be driven by a 400-horsepower, double-armature motor turning at 140 revolutions per minute. The power for auxiliaries, lighting and excitation purposes will be furnished by two 40-kilowatt exciters driven off the main engines. The Ward-Leonard system of variable-voltage control will be used, and operating controls will be located in both the pilot house and the engine room.

# The New City of Galveston Fireboat

## Building at the yard of J. S. Schofield's Sons from plans by Cox & Stevens

A MODERN fireboat for the city of Galveston, Texas, is being built at the yard of J. S. Schofield's Sons, Macon, Ga. A contract for this work was awarded May 21, 1928, and the vessel will go into active service about the first of February, 1929. Upon completion of the hull, the fireboat will be towed to the yard of the Gibbs Gas Engine Company of Florida, Jacksonville, Fla., where the engines will be installed and the vessel fitted out. This fireboat was designed by Cox & Stevens, Inc., naval architects, New York city.

### Hull Particulars

The hull is of steel construction with the exception of the wooden fenders, main rail, decking over fuel tanks on the main deck and the housetops. The principal dimensions of the vessel have been made as small as possible to permit rapid maneuvering in restricted places. These are listed as follows:

| | |
|---|---|
| Length overall | 87 feet 9 inches |
| Length on waterline | 85 feet 0 inches |
| Beam, over guards | 19 feet 6 inches |
| Beam, molded | 18 feet 0 inches |
| Draft, mean | 6 feet 0 inches |

The hull is subdivided by four transverse watertight bulkheads forming a fore peak, forward hold, machinery compartment, after hold and aft peak. All bulkheads extend to the main deck.

Gasoline is carried in four independent tanks having a total capacity of 2700 gallons. This will be sufficient to operate all engines for a period of 18 hours.

Fresh water is carried in two double-bottom tanks, one in each hold, and will be used for trimming ship and washing purposes.

The deck house contains a raised pilot house, nozzle room, pantry, deck toilet and companionway to the engine room.

### Power Plant

The vessel will be propelled at a speed of 12 statute miles per hour by twin screws, each driven by a six-cylinder direct-connected Winton model W-5 gasoline engine, having an 8-inch bore, an 11-inch stroke, and developing 125 brake horsepower at 450 revolutions per minute. The propellers will be of bronze of the three-bladed, solid type. The propeller shafts, where exposed to sea water, will be protected by rubber sleeves manufactured by the United States Rubber Company.

The pump engines will consist of two Winton model 130, 500-brake horsepower, eight-cylinder, marine gasoline engines having a bore of 8 inches and a stroke of 10 inches. Each engine will be direct connected to a two-stage, type S. I., centrifugal pump of American Well Works manufacture. Each pump will be capable of discharging a minimum of 3750 gallons per minute at 150 pounds pressure and 1100 revolutions per minute. The pump suction will be 12 inches and the discharge 10 inches in diameter. A 2-horsepower motor-driven "hytor" exhauster, manufactured by the Nash Engineering Company, will be provided for instantly priming the pumps. The pumps will be arranged to discharge into a common header from which the stand pipes, hose manifolds and chemical hose connections will take their supply.

Both propelling and pumping engines will be equipped with air starters, water-jacketed exhaust piping and Maxim silencers. Gasoline will be fed to the carburetors by a duplex system consisting of a set of Autopulse units on each engine and a gravity-feed system, which will be supplied by a totally-enclosed 1/3-horsepower Viking gasoline pump.

Two Winton model 123 auxiliary air compressors, each driven by a one-horsepower motor, will be installed to provide starting and service air. One set will serve as a spare.

A Westinghouse 5-kilowatt motor-generator will be provided to permit the use of shore current when the boat is at station.

### Equipment

The vessel is equipped with a size A, drum-type, electric steering gear manufactured by the American Engineering Company. Electric illumination is used throughout. Two Winton model W-2A, 10-kilowatt, 110-volt, direct-current, gasoline engine-driven generator sets supply electricity for lighting and also supply power for all auxiliary motors.

The motor-driven auxiliaries will include one 26-E.Z., 5-horsepower, Northern Rotary fire and bilge pump, capable of delivering 100 gallons per minute against a pressure of 50 pounds; and a Hisey motor-driven bench grinder. Cory engine and pump telegraphs will be provided in the pilot house, and two Sperry 18-inch incandescent searchlights will be installed. One will be placed on top of the pilot house and the other on the tower.

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A type G No. 4 electric windlass, manufactured by the American Engineering Company, will be provided on the main deck forward for handling lines and anchor chain. The ground tackle will consist of 60 fathoms of ¾-inch B B B chain, two stockless anchors of 525 pounds each, one kedge anchor weighing 280 pounds and 60 fathoms of 4-inch circumference manila rope.

A 2000-cubic feet per minute exhauster, to be located in the deck house, will remove foul air from the engine room through suitable ducts and two 2000-cubic feet per minute blowers will supply fresh air to the engine room and tank compartments. All ventilation sets will be manufactured by the Ilg Electric Ventilating Company.

Over each tank space there will be one 12-inch ventilator, in addition to four gooseneck vents. All vent openings will be fitted with wire mesh.

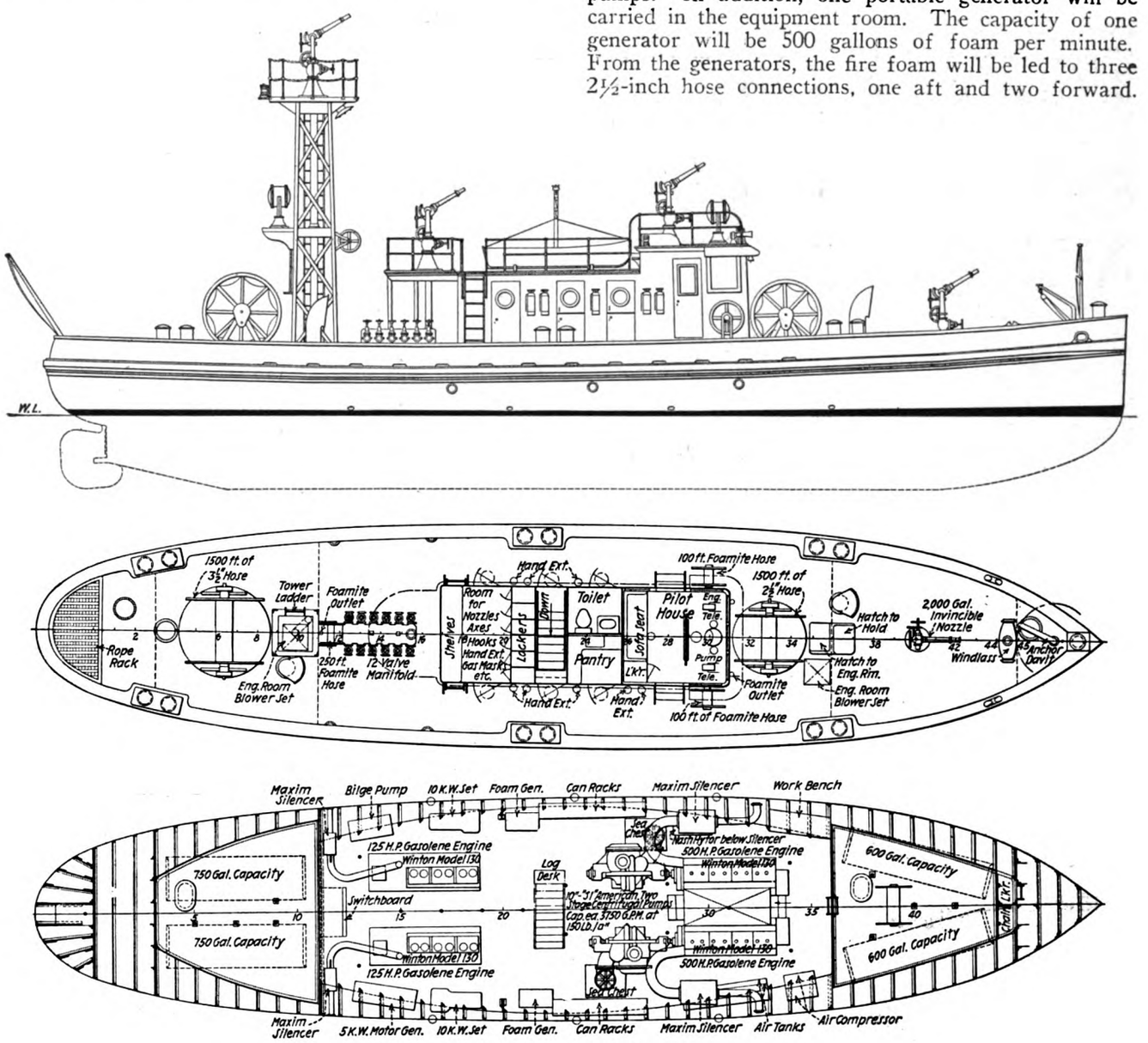
A Tyfon air whistle, operated by compressed air from starting air bottles through a Leslie reducing valve, will be provided.

## Fire-Fighting Equipment

There will be four 4-inch standpipes, each fitted with a 2000-gallon Woodhouse Invincible nozzle, one to be mounted on the main deck, two on top of the houses and one on top of the tower.

For fighting oil fires, two Foamite generators, manufactured by the American-La France and Foamite Corporation, will be located in the engine room and arranged to take water supply from fire and main pumps. In addition, one portable generator will be carried in the equipment room. The capacity of one generator will be 500 gallons of foam per minute. From the generators, the fire foam will be led to three 2½-inch hose connections, one aft and two forward. The aft hose connection will have 250 feet of rubber-lined hose in 50-foot lengths with nozzle and reel on the tower, while the forward ones each will have 100 feet of hose on reels on the sides of the pilot house. Stowed in the engine room will be 90 cans, each containing 45 pounds of powder. This amount of powder will assure continuous service, with two generators in operation, over a period of one-half hour. Both gasoline tank compartments and the engine room will be fitted with Foamite outlets, suitably located.

There will be one hose manifold on the main deck




**Profile and deck plans of new Galveston fireboat**

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located aft of the house with twelve 3½-inch hose outlets. All hose outlets will be controlled by high grade bronze gate valves, fitted with reducers to suit 2½-inch hose. Two swiveling hose reels, made by John W. Sullivan Company, will be placed on the main deck. One reel will hold 1500 feet of 2½-inch hose and the other will hold 150 feet of 3½-inch hose. One hose reel located in the forward hold will carry 500 feet of 2½-inch hose.

The main deck rail will be fitted with six sockets on each side of the vessel for supporting hose rail holders. Six hose rail holders of the New York fireboat type will be supplied with the equipment. Ten 2½-gallon, copper-tank, hand-fire extinguishers will be provided. A perforated pipe will be carried along the underside of the bulwark rail and around the top of deck house to produce a water screen for the protection of the boat when operating close to a fire. Stowage will be provided in the nozzle room on the main deck for an assortment of nozzles, smoke helmets and miscellaneous fire-fighting equipment. One portable two-horsepower Evinrude centrifugal pump will be carried in the equipment room for salvage work.

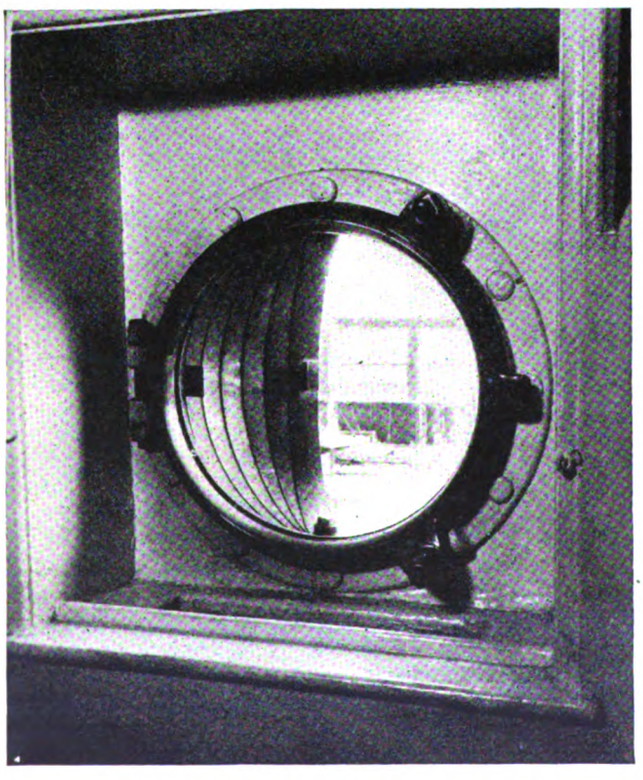
## Folding Windscoop

WITH the installation of 140 folding windscoops on the Panama-Pacific liner Virginia, the Kearfott Engineering Company, Inc., New York city, has introduced a type of windscoop for ship installation that does not require removal when the air-port is closed. This windscoop, which is manufactured under the Norton patent, will effectively divert a stream of passing air into the port and may be permanently stowed in the airport ring when not in use.

As shown in the illustration, the windscoop is made up of several leaves of thin, non-corrosive chrome-alloy steel, nested together on two pivots that are tapped into the air-port ring. Interference pieces are formed on the edges of the leaves so that each leaf will open or close the adjacent leaf when the scoop is expanded or collapsed by the hand grips. The two pivots are locked so that they cannot turn with the motion of the leaves. The friction between the leaves at their ends, which insures their staying in any desired position, is readily adjustable.

The scoop, it is claimed, performs its function more efficiently than the common straight type of windscoop, because the easy curvature turns the collected air at right angles to its course with a minimum of turbulence. The windscoop is easily opened, when the air-port is open, and does not have to be removed when the air-port is closed. The amount of ventilation desired can be regulated by partial or full opening of the scoop. If ventilation is desired from a following breeze, the scoop may be swung around to the opposite side. When the leaves are closed, they nest inside the rim of the air-port, and offer no obstacle to the free passage of light, as they lie outside the area of the glass.

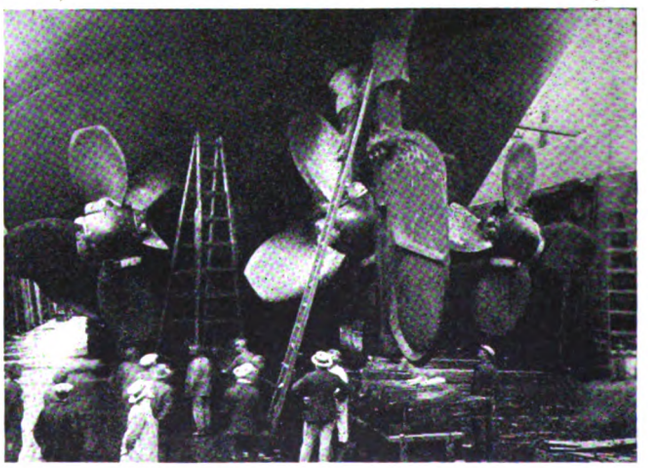
The scoop may easily be fitted into air-ports of standard construction by drilling and tapping into the ring. All parts of the scoop are made of non-corrosive metal, the best for this purpose being stainless steel. The scoops are now made up in various sizes to fit different model air-ports.



**Folding windscoop with air-port closed**

## New Welding Rod Developed

THE Fusion Welding Corporation, Chicago, Ill., has announced the development of a special-purpose welding rod, known as "Weldite Yellow Jacket." This new product is a mild-steel electrode of high quality. Compared to the ordinary bare mild-steel rod, it is said to give 25 to 50 percent more penetration, 15 to 30 percent more tensile strength and 10 to 20 percent more ductility.



**Soviet ice breaker Krassin on dry dock after her return from the rescue of the crew of the Italia**

The photograph shows plainly the effect of the vessel's encounter with the ice in the Arctic. It was found necessary to re-metal each of the stern bearings. Each bearing required about 1600 pounds of metal. The Krassin is 323 feet long overall, 71 feet beam and 41 feet depth, with a displacement of 10,500 tons. Her propelling machinery develops 10,600 horsepower. Steam is supplied at 180 pounds per square inch by ten 3-furnace Scotch boilers. The main shafts are 17½ inches in diameter. The propellers weigh 14 tons and are fitted with nickel steel blades.

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# Vickers-M.A.N.Double-Acting Engine

## Units developing 4000 brake horsepower to be installed in British submarine mother ship

By Our London Correspondent

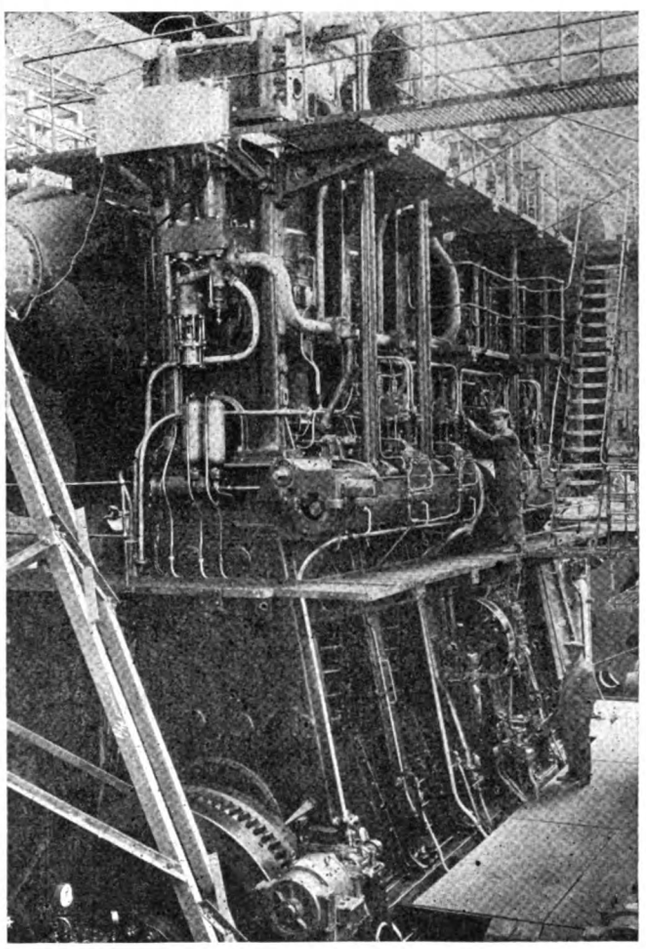
IN view of the fact that considerably more motorships have been constructed in Great Britain than in any other country, the progress which has been made with the double-acting two-stroke engine is surprisingly small. It is possible that this is due partly to the fact that the first motor of this class which was placed on the market, the North British sliding-cylinder design, did not prove successful in practice and, when two or three of these engines were installed in ships, it was found at a later date desirable to replace them by other machinery.

From the standpoint of pure reason, this failure should not have acted against the double-acting two-stroke principle, but undoubtedly it did. A secondary reason for the two-stroke double-acting engine remaining in the background is that so much progress has been made with the four-stroke double-acting type, and also with the Doxford opposed-piston design, both of which can be built in powers equal to those of the double-acting two-stroke models, that the necessity for the adoption of this latter type did not arise so urgently as was the case in other countries, for instance in Germany, where neither of the two types has been developed to any extent.

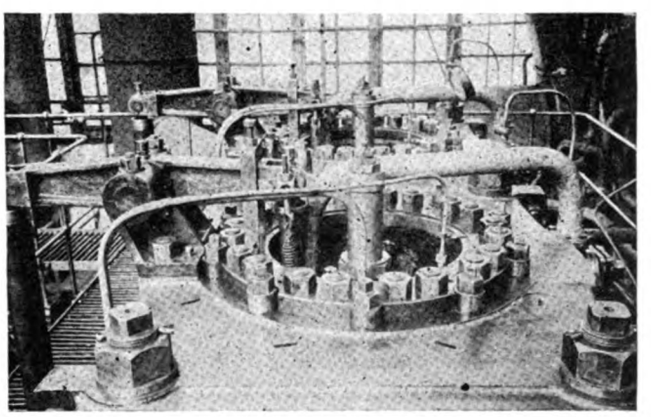
### Vickers Secures M. A. N. License

Nevertheless, a certain amount of experimental work on two-stroke double-acting engines has been carried out in England and at the present moment there is being manufactured the first of the Richardsons Westgarth engines to be installed in a ship. About a couple of years ago, Vickers, now Vickers-Armstrong, came to the conclusion that they must develop an engine in very high powers, possibly with the likelihood of building motor war vessels in the future, and they came to an agreement with the Maschinenfabrik Augsburg Nurnberg to manufacture their engines under license.

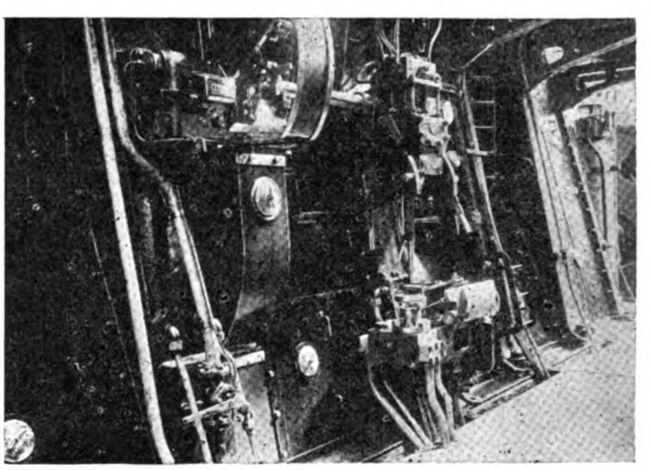
A little later, the British Admiralty placed an order for a large submarine mother ship, the *Medway,* which was recently launched, and in this ship are to be installed the first of the Vickers-M. A. N. engines built. These ran trials towards the end of August and the be-



**4000 brake horsepower Vickers—M. A. N. double-acting engine for the submarine mother ship Medway**



**Top of cylinder**



**Control station of the engine**



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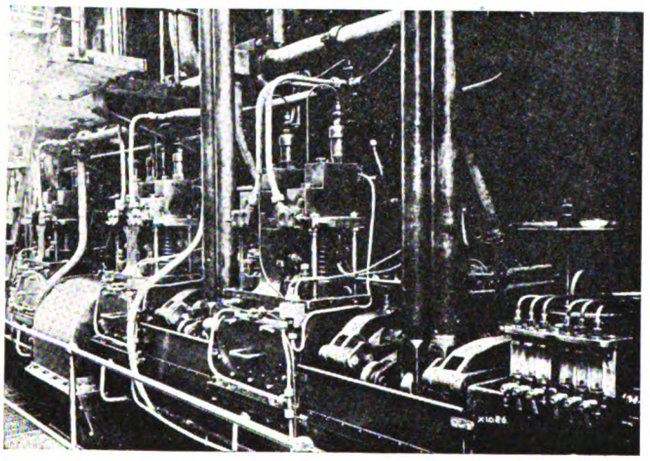
ginning of September and, as the first of their class, aroused considerable interest in engineering and shipbuilding circles.

A further reason for Vickers' adoption of this design is that, with the paucity of orders for war vessels, they have now set out to build passenger liners and naturally wish to be in a position to compete for any motor passenger vessels that may be required. At the present time they have not built any such craft and the Diesel engine of their own design built many years ago, a four-cycle single-acting type, is scarcely suitable for high-powered ships.

### Medway Engines of Conventional Design

It cannot be said that in the engines which Vickers have built for the *Medway*, they have introduced many new features. The design is, in fact, in practically all details, the same as that of the M. A. N., adopted in many engines now in service. Even the cylinder dimensions are of standard size, being the same as those



**Cam shaft and fuel pumps**

of the engines in the *Augustus* and the machinery fitted in a large number of passenger ships, including the new Hapag cargo and passenger vessels for the Hamburg-San Francisco trade.

There are four cylinders, with a diameter of 700 millimeters and a piston stroke of 1200 millimeters and at 115 revolutions per minute the rated power is 4000 brake horsepower. As the engine drives its own scavenging pumps, also the air compressor, this rating appears to be somewhat liberal, compared, for instance, with the engines of the *Augustus*. These units do not drive their own scavenging pumps and are rated at 1100 brake horsepower per cylinder at a speed of 120 revolutions per minute.

Originally, the M. A. N. double-acting engine was arranged with four fuel valves in the bottom cylinder cover, but in the new design this has been modified so that only two sprayers are required. Starting-air valves are also fitted only in the bottom cover so that at the top there is but one centrally placed fuel valve.

The system of reversing also follows M. A. N. standard practice. There is a single lever for maneuvering, controlling the starting for ahead and astern, according to its movement to the right or to the left. It operates a servo-motor, which lifts the valve levers off the cams, moves the cam shaft and brings the starting-air valve levers again on to the cams, so that compressed air at a pressure of 350 pounds, per square inch is admitted through the horizontal starting-air valves at the bottom of the cylinder. There are two hand wheels, one for the control of the amount of fuel admitted to the cylinders, thus varying the speed, while the other is an air-control wheel, regulating the suction of the air compressor.

### First Engines Not Particularly Light

It might be thought that double-acting two-stroke machinery would show a great advantage in the matter of weight compared with the other types, but this engine weighs 380 tons, the equivalent figure per brake horsepower being 212 pounds. This is, of course, substantially lower than a four-stroke or a two-stroke single-acting motor operating at the same speed, but it can be equalled or improved upon by fast-running trunk-piston machinery. It should be added, however, that the engines of the *Medway* were designed a considerable time ago and that, with the recent improvements introduced by the M. A. N., the saving in weight is substantial and a figure more nearly in the neighborhood of 150 pounds, per brake horsepower, can be achieved. The fuel consumption of this engine works out at approximately 0.4 to 0.41 pound per brake horsepower per hour.

As regards the *Medway* itself, it will probably be the most notable submarine mother ship afloat, for its equipment comprises some remarkable features. Throughout, electricity is utilized for every possible purpose and a large generating plant, driven by Diesel engines, is to be installed. It is anticipated that she will be placed in commission during the course of 1929.

It is interesting to record that the French Admiralty placed an order some months ago for a submarine mother ship also to be driven by Diesel machinery. Curiously enough, the machinery is to be of equal power, namely of 8,000 brake horsepower, but Sulzer engines constructed in France are to be installed, and they will be considerably lighter, for they will operate at 220 revolutions per minute.

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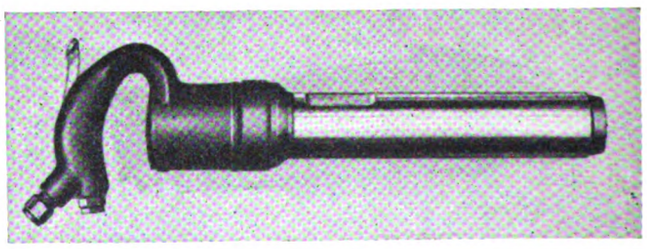
# New-Style Riveting Hammers

A NEW line of riveting hammers in four sizes, having strokes of 5 inches, 6 inches, 8 inches, and 9 inches, has been developed by the Ingersoll-Rand Company, 11 Broadway, New York city.



**New Ingersoll-Rand riveting hammer**

The new hammers have several improved features of construction which insure reliable and economical service.

An important feature is the manner in which the handle is fastened to the barrel and kept tightly in place by a spring-locking device. The handle is threaded on to the barrel and the spring lock not only prevents the handle from unscrewing but applies tension to tighten it automatically.

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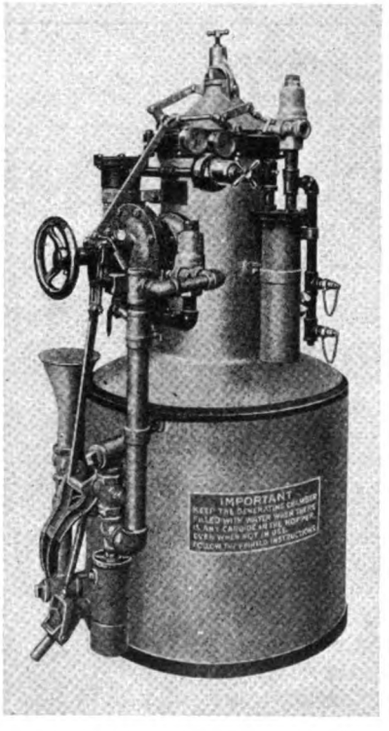
The valve operates in a hardened and ground valve box located at the head of the barrel and clamped in place by the handle. The valve box has a solid upper end which provides a positive compression chamber for the piston on its up-stroke. It acts to prevent the piston from striking the handle end as this air cushion is not dependent upon an air-tight joint between the handle and the barrel.

An open-type outside trigger handle is furnished, but closed or inverted type handles can also be supplied.

## Large Capacity Acetylene Generator

THE Oxweld Acetylene Company, New York city, has developed a new type of medium-pressure acetylene generator, designated as Type MP-3. This new piece of equipment is designed to carry 300 pounds of carbide together with a large supply of gas with a minimum-pressure fluctuation and with a minimum expense for maintenance.



**Oxweld large capacity acetylene generator**

The same principle of carbide feed that has been employed in the popular Oxweld balance seal generator is used in the Type MP-3. The feed is driven by a motor actuated by a weight. A diaphragm pressure control is used in connection with the motor to regulate the feed and maintain proper pressure in the generator. The feed-shaft bearing is protected by a dust-proof cover which protects it from carbide dust. Two changing doors facilitate filling the hopper. For maximum durability some gears are made of bronze and monel metal and certain shafts are of special alloys. The brake control on the motor is positive in action and does not require frequent adjustment once it is set.

A clean-out door is provided which permits cleaning the carbide feed disk without removing the generator top. The filter can be repacked, if necessary, without breaking any adjustment of interference or relief valves. This operation is performed by removal of the top plate.

The hydraulic back-pressure valve is so arranged that it is always filled with water before the generator itself is entirely filled. An overflow-level check plug has been provided in order that the operator may check the water level at any time.

When recharging is necessary, the interference, which is of simple and sturdy construction, operates the relief valves, locks the feed motor so it cannot operate, and permits the carbide doors and water filling cock to be opened.

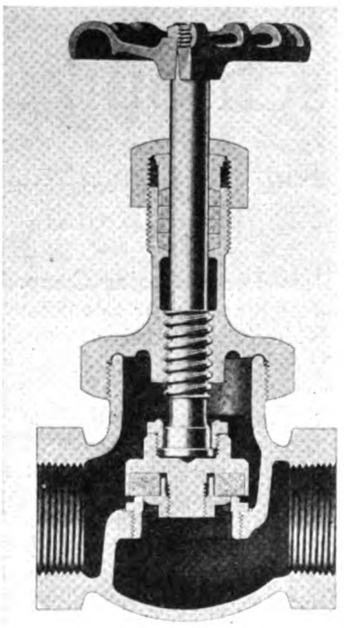
The operating pressure can be changed by turning the adjusting nut on the feed control. During normal operation, the set pressure will not vary more than about 1 pound.

The Type MP-3 generator consists essentially of two sections, the lower being a cylindrical shell, the upper a shell in the shape of a truncated cone. The bottom is dished for maximum strength. All seams are bronze welded, both inside and out.

This generator uses 1¼ by ⅜-inch carbide. The overall height is slightly over 120 inches and the height to the top of the generator shell is 104 inches. The diameter of the shell is 42½ inches and the shipping weight is 2300 pounds.

## New Jenkins Valve

JENKINS Bros., valve manufacturers, 80 White street, New York city, announce a new line of bronze valves with renewable resilient disks. The valves are designed for steam pressures of 250 pounds per square inch. The disk, being more resilient than the metal, readily conforms to the seat and insures a tight valve without regrinding.



**Cross-section of Jenkins valve**

The line comprises globe, angle, cross and horizontal and angle check patterns furnished screwed or flanged in sizes ranging from ¼ inch to 2 inches. The globe, angle and cross patterns are furnished with renewable seat-rings. The bonnet screws over the body, a construction which adds strength. The bonnet seat joint is rounded, a feature which also provides strength and at the same time allows easy removal of the bonnet.

Other features of the globe, angle and cross patterns include: Non-heat hand wheel of malleable iron; bronze gland, which aids in preventing leakage around the spindle; deep stuffing-box generously packed with asbestos ring-packing; and manganese bronze spindle with large, powerful threads, all of which are in contact with the bonnet threads when the valve is closed.

MARINE SECTION, NATIONAL SAFETY COUNCIL EXCURSION.—In addition to the meetings of the Marine Section of the National Safety Council at its annual congress in New York city, October 1 to 5, there will be an excursion during the period from the Hotel Pennsylvania to the plant of the American Abrasive Metals Company, Newark, N. J., where methods of manufacturing abrasive-surfaced metals for deck plates will be observed.

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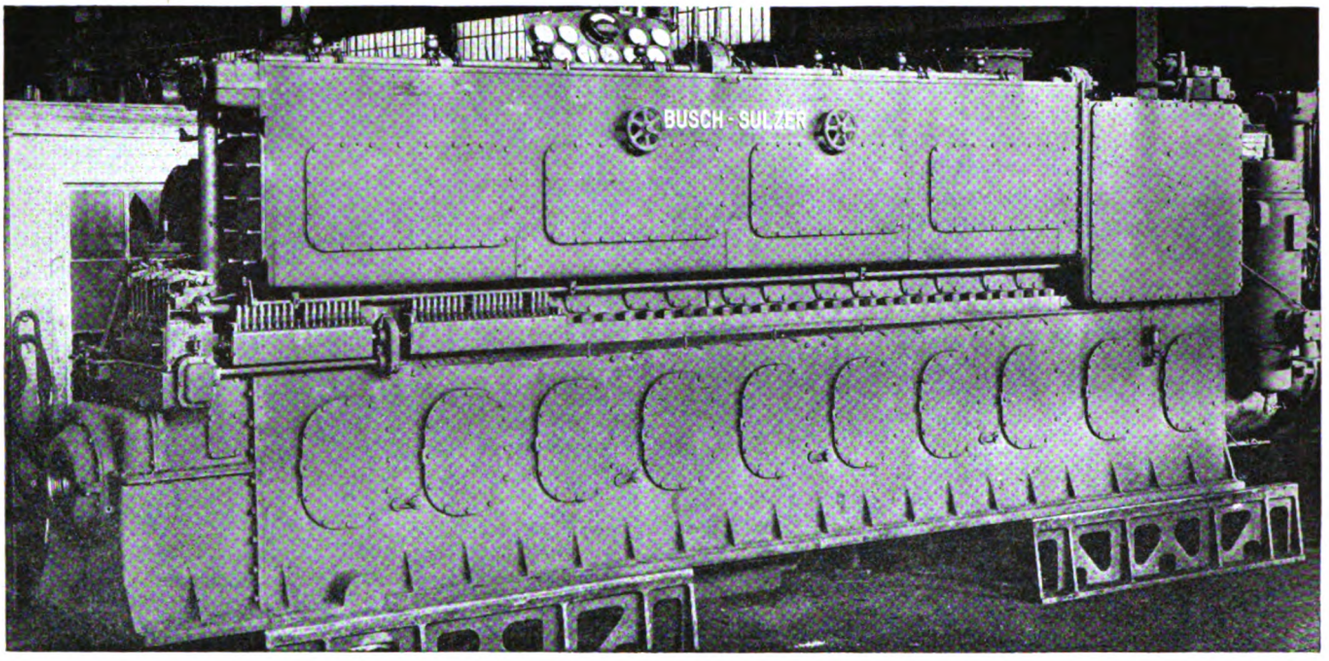


**Fig. 1.—Front view of the eight-cylinder, type E Busch-Sulzer Diesel engine**

# New Busch-Sulzer High-Speed Diesel

## Ruggedly constructed type E Diesel engine supplied in units up to 1200 horsepower

THE Busch-Sulzer Bros.-Diesel Engine Company, St. Louis, Mo., has announced the development of a light-weight, high-speed Diesel engine that is suitable for direct or electric drive of small boats and for electric drive in large vessels.

The type E Diesel, as the new engine is designated, has been developed without essential modification of the well established 2-cycle design which has gained an excellent reputation in submarine service during the past ten years. These submarine type engines are costly, and, in some designs, are not sufficiently rugged for heavy duty service.

This new engine is considerably heavier than the submarine type and is more rugged than its predecessors for commercial operation. Where the submarine type weighed as low as 55 pounds per horsepower and was designed for safe operating speeds as high as 450 revolutions per minute, developing 2500 horsepower, the weight of the new commercial engine is around 100 pounds per horsepower. This varies somewhat with the speed selected to fill the requirements of the individual installation.

The new commercial engine is suitable for marine service where space and weight limitations are guiding factors in the selection of a Diesel power plant. Speed may be temporarily increased to 50 percent above the normal engine speed without danger or serious loss of efficiency.

Fig. 1 shows the front view of the 1200-horsepower, 8-cylinder engine. At the control station the two hand wheels are for injection and starting air; the two vertical hand levers are for starting and stopping, each lever controlling a bank of four cylinders.

The bed plate is of single casting whose seating flanges are flush with the bottom of the base, facilitating installation. The inboard bearing for thrust or fly-wheel shaft is built integral with the bed plate. The rigidity of the bed plate is increased by bolting to the top block cylinder castings, which also enclose the crank case in an oiltight housing.

The duplex scavenging pump is located at the right of the engine. Valves of the automatic blade type control the admission of scavenging and charging air to the cylinders through the upper tier of cylinder ports. The exhaust ports connect with a water-cooled manifold placed along the rear of the engine frame, as shown in Fig. 2.

Each cylinder head contains but one valve. This permits a symmetrical casting of simplicity and safety. The fuel-valve driving mechanism is offset to obviate the necessity of packing around the fuel needle. This insures the smooth opening and closing of the fuel valve.

The piston and connecting rod are of Busch-Sulzer design. The wrist-pin bearing is a one-piece bushing.

The fuel pump, mechanical lubricator, governor and fuel-priming pump are placed at the after end of the engine. The mechanical lubricator has a separate plunger for each feed to the working and compressor cylinders, provision being made for lubrication at four points on the circumference of each working cylinder.

The injection air-compressor shown in Fig. 3, is lo-



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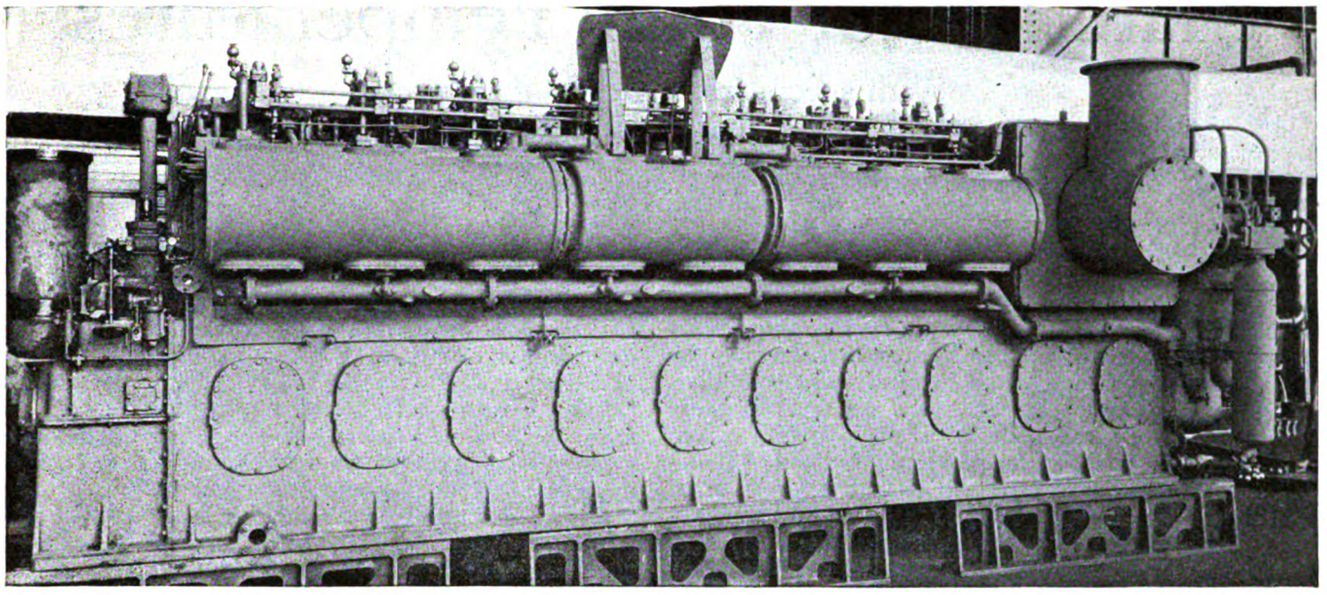

Fig. 2.—Rear view of type E engine showing the special water-cooled exhaust header

cated at the forward end. All valves are set in quickly-removable cages, readily accessible. Straight-tube vertical coolers reduce the air temperature after each stage of compression. Separators at their lower ends of the coolers, permit draining off accumulated condensation. Removable heads, and large hand holes on the coolers allow for easy inspection and cleaning of tubes and water spaces.

The fuel pump has one plunger per working cylinder. The position of the governor determines the relative time of closing of the pump-suction valves, thus regulating the amount of fuel actually delivered. Individual adjustment is obtained by thrust screws in controlling arms, and separate latches are provided to cut out individual cylinders. The driving parts of the pump are readily accessible through sliding doors and a single cover plate below.

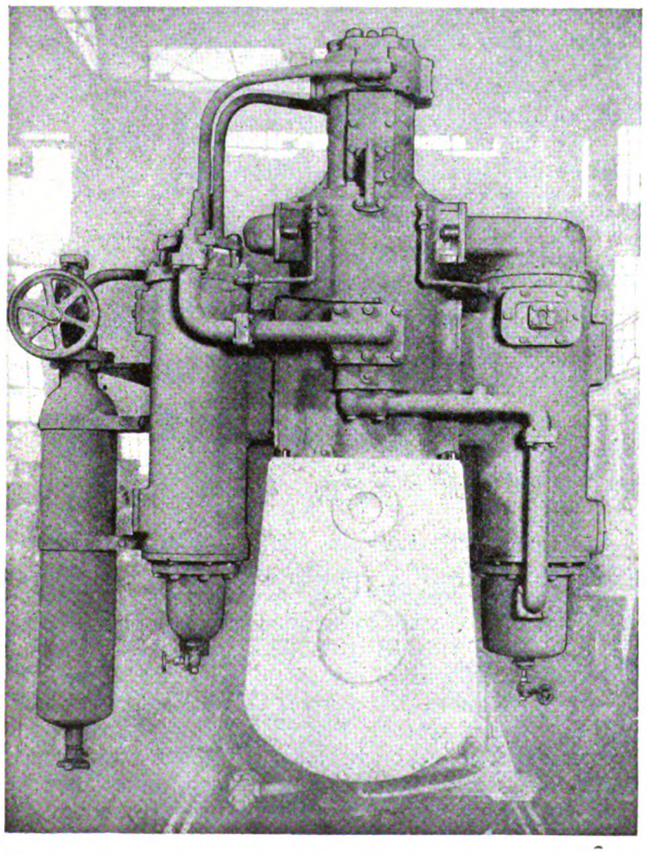

Fig. 3.—Forward end of type E Diesel engine showing the injection air compressor

### Centrifugal Type Governor

The governor is of the fully inclosed, centrifugal type, driven by a separate vertical shaft geared directly to the crank shaft. The engine speed, through the governor, fixes the position of a horizontal shaft to which a dash-pot is attached. This shaft is linked to the eccentric valve of the air compressor to regulate the injection air automatically to suit the load. Hand-wheel adjustment of governor-spring tension is provided for synchronizing.

Should the engine speed exceed a predetermined limit, a cetrifugal device on the pump shaft trips two blocks and releases the suring-loaded vertical rod. This rod then turns the eccentric shaft on which the controlling arms are mounted and holds open all suction valves, suspending delivery of fuel and stopping the engine.

## New Dry Dock at Quebec

A RAILWAY dry dock, designed by the Crandall Engineering Company, Boston, Mass., is now being constructed at Levis, Quebec, for the ship repair firm of George T. Davie & Son. The cradle of this dry dock which has a capacity of 1800 tons will be 250 feet long on the keel blocks and 68 feet wide. It will have 15 feet of water over the keel blocks forward and 24 feet aft at spring high tides. The track is of the three-way type, the upper part being of reinforced concrete and the underwater part of standard wood construction on a foundation of wood piling. The hoisting machinery is to be operated by steam and is expected to haul a capacity load in less than 30 minutes. It is expected that this dry dock will be completed before the end of the year.

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# Materials for High Temperatures*

## With special reference to their use in boilers supplying superheated steam

By Reginald George Cyril Batson

IT is now generally recognized by engineers that if the steam engine is to compete effectively with the internal-combustion engine, the initial temperature of the working fluid must be considerably higher than that which has hitherto been customary. In the development of steam plants to meet these conditions the principal limiting factor is the strength, at these temperatures, of the material used. Modern steam plants employ an inlet temperature of about 400 degrees C. (750 degrees F.), and from consideration of the properties of ordinary mild steels at high temperature, a temperature of this order appears to be a maximum. Professors A. L. Mellanby and William Kerr have expressed the opinion that 480 degrees C. (896 degrees F.) represents an upper limit of temperature in the near future, even allowing for fair advance by the metallurgist.

Boiler pressures have advanced in recent years for the larger land plants from 200 to 800 pounds per square inch, with a few cases of much higher pressures up to 1,570 pounds per square inch. In this direction, Professors Mellanby and Kerr, starting with an upper limit of temperature of 900 degrees F., have deduced from considerations of thermal efficiency that although "there is little indication of any real pressure limit . . . the period of rapid improvement with pressure is within the first 1,000 pounds of increase," and "1,250 pounds per square inch must be close to a true upper limit."

Mr. John Anderson, as a result of wide experience, stated that the maximum temperature to which boiler-tubing of 0.16 percent carbon steel, with a yield stress of 20 tons per square inch and an ultimate tensile strength of 25.9 tons per square inch, could be subjected without failure was approximately 480 degrees C. (892 degrees F.). It is known that this type of steel would have an ultimate tensile strength (when obtained in the usual way) at 480 degrees C. (892 degrees F.) of about 20 tons per square inch, which would appear to give a reasonable factor of safety.

Recent research has shown, however, that the tensile strength of materials, at high temperature, obtained by the ordinary methods of testing at air temperature, is misleading. It has also been found that at high temperature a stress much lower than the ultimate tensile stress will cause failure of any material if prolonged for some time. This is due to creep or flow of the material with time. Further, it has been shown that for each temperature there is a stress below which the material will not fail or will last for many years. This stress has been called the limiting creep stress.

There is considerable difference of opinion as to the method by which this limiting creep stress should be determined, and the results published by different experimenters show in some cases considerable variation for apparently similar materials. Two conditions are met with in design:

(a) Where no permanent deformation is admissible.

(b) Where permanent deformation can be allowed provided failure does not result.

There is probably a temperature where the maximum stress for both conditions is coincident, that is to say, where, if permanent deformation occurs, failure results. On the other hand, at a lower temperature permanent deformation can occur without failure. This is due to the fact that at such a temperature the material "strain" hardens under stress and temperature, owing to creep or flow without appreciable softening, and the creep ultimately ceases, whereas at a higher temperature there is appreciable softening, and flow continues.

It does not necessarily follow that the limit of proportionality obtained in the usual way at high temperature gives the stress for condition (a). The test is carried out in less than an hour, and creep may occur at such a low rate that it is not perceptible during the test. The value obtained would be on the high side.

These values indicate the extremely rapid decrease in the limiting creep strength of boiler-tube steels as the temperature is raised above 400 degrees C. (752 degrees F.). At a temperature of 525 degrees C. (977 degrees F.) the actual working stress in the tubes may be equal to the limiting creep stress, as in the case of Mr. Anderson's high-pressure plant.

TABLE I.—STEEL FOR BOILER AND SUPERHEATER TUBES

| Temperature | | 0.10 percent Carbon Steel | | | 0.17 percent Carbon Steel | | |
|---|---|---|---|---|---|---|---|
| C. degs. | F. degs. | Limit of Proportionality, tons per sq. inch | Ultimate Tensile Stress, tons per sq. inch | Limiting Creep Stress, tons per sq. inch | Limit of Proportionality, tons per sq. inch | Ultimate Tensile Stress, tons per sq. inch | Limiting Creep Stress, tons per sq. inch |
| 400 | 725 | — | — | — | 6.5 | 22.0 | 13.4 |
| 450 | 842 | — | — | — | 5.5 | 24.5 | 8.5 |
| 480 | 896 | 4.0 | 17.0 | 5.5 | 5.0 | 21.5 | 6.0 |
| 500 | 932 | 3.3 | 14.9 | 3.5 | 4.8 | 19.4 | 4.8 |
| 525 | 977 | 2.9 | 13.7 | 2.0 | 4.4 | 17.0 | 3.5 |
| 550 | 1022 | 2.5 | 21.1 | 1.3 | 4.0 | 15.0 | 2.4 |
| 570 | 1058 | 2.2 | 10.5 | 1.0 | 3.5 | 13.0 | 2.0 |
| 600 | 1112 | 1.9 | 8.4 | 0.6 | 2.8 | 11.0 | 1.2 |

These values were obtained by interpolation from plotted experimental observations.

Results expected from steels used for boiler and superheater tubes, and superheater and steam drums are given in Tables I and II.

TABLE II.—0.23 PERCENT CARBON STEEL FOR SUPERHEATER AND STEAM DRUMS

| Temperature, | | Limit of Proportionality, tons per sq. inch | Ultimate Tensile Stress, tons per sq. inch | Limiting Creep Stress, tons per sq. inch |
|---|---|---|---|---|
| °C. | °F. | | | |
| 400 | 752 | 6.3 | 26.0 | 13.5 |
| 470 | 878 | 5.3 | 18.5 | 7.0 |
| 530 | 986 | 4.0 (Approx.) | 16.4 | 4.0 |

Practically all metals are subject to failure by intercrystalline cracking if the temperature is high enough. There is evidence that this type of failure may occur with boiler-tube steel at temperatures of about 600 to 650 degrees C. (1,112 to 1,202 degrees F.). Further, this steel readily oxidizes in the presence of air at a temperature above 570 degrees C. (1,058 degrees F.).

It is clear, therefore, that if working pressures and temperatures are to be raised much above their present limits, say, 800 pounds per square inch, materials other than those now employed must be used for boiler and superheater tubes. For this purpose a material is required which will give the mechanical and physical prop-

* From the Liverpool *Journal of Commerce*.



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erties at 500 degrees C. (932 degrees F.) obtained with the present low-carbon steels at 400 degrees C. (752 degrees F.), but with no (or very small) addition to the cost. That is to say, a limiting creep stress of about 13 tons per square inch is required at 500 degrees C. (932 degrees F.), with good ductility at normal temperature.

The position as regards materials other than low-carbon steels is as follows:

*Carbon Steels.*—Increasing the carbon content reduces the ductility and increases the limiting creep stress, but only to a very small extent; 0.51 percent carbon steel with an ultimate tensile strength of 500 degrees C. (932 degrees F.) of 25.7 tons per square inch has a limiting creep stress of about 5 tons per square inch.

*Alloy Steels.*—Very little information is available on the properties at 500 degrees C. (932 degrees F.), and over, of steels containing additions of other elements such as nickel, chromium, cobalt, vanadium, etc. The general indication, however, is that:

(a) The improvement is not appreciable when the amount of the additions is small (3 to 4 percent).

(b) Where the amounts added are large the gain in strength is considerable. Among steels of this class are:

(1) High-speed steel (14 to 18 percent tungsten).
(2) High-chromium steel (12 to 14 percent chromium).
(3) High-chromium—high-nickel steel.
(Nickel not less than 20 percent)
(Chromium not less than 12 percent)
(Tungsten 0 to 12 percent)
(4) Cobalt-chromium steel.
(Chromium 11 to 14 percent)
(Cobalt 3 to 5 percent)
(Molybdenum up to 1 percent)

Mr. J. H. S. Dickenson has shown that steels (1) and (2) have a limiting creep stress of 8½ tons per square inch at 575 degrees C. (1,067 degrees F.) and 520 degrees C. (968 degrees F.) respectively, while Mr. P. Chevenard in France has developed steels (3) and finds that they have high resistance to creep at the temperature under consideration.

*Non-Ferrous Alloys.*—An alloy of 70 percent of nickel with 30 percent of chromium (in the rolled condition) has been thoroughly investigated, and the results obtained show considerable advance (as regards strength at high temperature) over other materials which have been considered. Values are given in Table III:

TABLE III.—NICKEL-CHROMIUM ALLOY

| Temperature °C. | Temperature °F. | Limit of Proportionality, tons per sq. inch | Ultimate Tensile Strength, tons per sq. inch | Limiting Creep Stress, tons per sq. inch |
|---|---|---|---|---|
| 500 | 932 | 15 | 45 | 24 |
| 590 | 1,082 | 12 | 40 | 16 |
| 650 | 1,202 | — | 35 | 9 |
| 700 | 1,292 | 5 | 29 | 6 |

Messrs. Dickenson and Chevenard have also experimented with alloys of this type and have shown their superiority.

It is thus possible to obtain materials that will meet the requirements for increased steam pressures and temperatures; but, as they involve the use of expensive alloys, their application at present in boiler construction is extremely limited. The present position, therefore, shows the great need for further research in order to obtain a material suitable for the needs of the "power-production" industry.

# Effect of Speed on the Cost of Ship Construction*

THE shipping world is watching with keen interest the effect of the Merchant Marine Act of 1928 upon the development of the American merchant marine, although too short a time has elapsed since its enactment to disclose any immediate results. The Shipping Board and Postmaster General have ruled that the mail subventions to be awarded thereunder and the loan fund provision should be used, as far as possible, to permit the building of larger and faster vessels than those now in operation. By requiring greater speed as a necessary feature of new vessels, they have presented one of the fundamental factors that determine the cost of building vessels.

While other features contribute to increase or to decrease the cost of a vessel, such as the requirements of the owner for economy of operation and for the comfort and safety of passengers and crew, yet speed is fundamental in the character of design and its effect on the cost of construction is immediate and far-reaching.

How much will it cost per deadweight ton to build a vessel of a certain tonnage and of a specified speed? This is the usual inquiry addressed to a shipbuilder by a shipowner intending to purchase a modern vessel. If the shipbuilder's price is greater than the owner anticipated, then he will ask for the reasons for the difference between the cost per ton of such a vessel and that of another of an entirely different size and of less speed.

The measure of the value of a vessel cannot be determined by its cost per ton, without full knowledge of the elements of design. It is believed that the shipping world in general is unfamiliar with the marked effect of speed and of other characteristics of design upon the cost of a vessel. Exclusive of other factors, the cost per ton varies with the size, the number of decks, the draft, the coefficient of fineness, the deck machinery, the equipment, the passenger accommodations, the amount of refrigeration, the steam pressure and most important of all, the speed.

If the owner of a vessel of 10,000 tons deadweight and of 10 knots speed intends to build another vessel of the same deadweight, but of 12, 14 or 16 knots, he will have to consider many factors that determine its cost. Thus each additional knot in speed requires an increase in horsepower; each increase in horsepower involves an increase in machinery weights; each increase in machinery weights requires a larger vessel to carry the machinery and the fuel for its operation. As a consequence, the cost of the ship will be increased for two principal reasons; because it is a larger ship, and because it requires heavier machinery.

Inasmuch as any increase in the speed of a vessel requires heavier machinery to develop the necessarily greater horsepower and as the machinery cost per pound is approximately three times the cost per pound of the weight of the hull, it will be seen that the total cost of the vessel of greater speed will mount rapidly although its deadweight tonnage will remain the same.

In order to throw light on this subject the National Council of American Shipbuilders has obtained the in-

* Statement issued by the National Council of American Shipbuilders, 50 Broadway, New York.

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formation appearing in the following table, which shows the approximate increases in the size of a vessel and in its weights and costs, when its speed only is changed and all other characteristics of the design remain the same.

Assume that a vessel has the following uniform characteristics: Single screw, 10,000 tons deadweight, 26 feet draft, machinery of high efficiency, geared turbines and watertube oil-burning boilers, the result will be as follows:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Speed in Knots | 10 | | 12 | | 14 | | 16 | |
| Dimensions | | | | | | | | |
| Length | 415 feet | | 441.5 feet | | 468 feet | | 495 feet | |
| Beam | 55.5 feet | | 58 feet | | 61 feet | | 65 feet | |
| Depth | 36 feet | | 36.25 feet | | 37.5 feet | | 38 feet | |
| Block Coefficient | 0.80 | | 0.762 | | 0.725 | | 0.69 | |
| Shaft Horsepower | 1900 | | 3650 | | 5800 | | 9200 | |
| Finished weights in tons of 2240 pounds each: | | | | | | | | |
| Hull | 3030 | 86 percent | 3400 | 82 percent | 3900 | 78 percent | 4600 | 75 percent |
| Machinery | 480 | 14 percent | 750 | 18 percent | 1080 | 22 percent | 1575 | 25 percent |
| Total | 3510 | 100 percent | 4150 | 100 percent | 4980 | 100 percent | 6175 | 100 percent |
| Comparison in percent using a 10-knot ship as 100 percent: | 100 percent | | 118 percent | | 142 percent | | 175 percent | |
| Building Cost: The cost of one ton of machinery is approximately three times the cost of one ton of finished hull weight. The resultant relative cost will be as follows: | | | | | | | | |
| Hull | 3030 | 67 percent | 3400 | 60 percent | 3900 | 55 percent | 4600 | 49 percent |
| Machinery | 1440 | 33 percent | 2250 | 40 percent | 3240 | 45 percent | 4725 | 51 percent |
| Total | 4470 | 100 percent | 5650 | 100 percent | 7140 | 100 percent | 9325 | 100 percent |
| Comparison in percent using a 10-knot ship as 100 per cent: | 100 percent | | 126 percent | | 160 percent | | 209 percent | |

The machinery weights include both propelling and deck machinery.

This table shows that a 16-knot vessel of 10,000 tons deadweight will cost more than twice as much as a 10-knot vessel; that a 14-knot vessel will cost 60 percent more and that a 12-knot vessel will cost 26 percent more.

As the speed and horsepower of a vessel increase, greater amounts of fuel and feed water are required with a consequent additional weight imposed on the vessel and a resultant decrease in its cargo capacity, both of which must be taken into account when vessels of high speed are considered.

The foregoing statement demonstrates the futility of comparing the cost of vessels on a tonnage basis alone, without carefully considering speed and all other factors that determine the cost of construction.

# Air Filter for Pipe Lines

A NEW type air filter for removing dust, water, oil, rust, scale and other foreign matter from air passing through pipes has been placed on the market by the Staynew Filter Corporation, Rochester, N. Y.

This filter consists of an aluminum housing, enclosed in a pressed steel housing which, it is claimed, will withstand a working pressure of 125 pounds per square inch. The filter which is mounted inside consists of a felt filter medium formed in pockets over radial wire screen fins grouped around a central outlet. This form permits mounting a relatively large area of felt in a compact space and allows the use of the entire available area of felt with a minimum restriction. The large capacity inserts are designed to pass 250 cubic feet of free air per minute and contain 20 square feet of felt within a volume slightly smaller than a cubic foot.

As air enters the top of the filter it is drawn against the inner wall of the steel housing by a shield over the top, the downward velocity carrying water, oil and most of the grit to the bottom of the shell. All remaining water, oil, dust and grit are caught by the filter. A drain cock is provided at the bottom to remove water, oil, etc.

By closing a valve to shut off the air going into the filter housing and opening the drain cock the air in the outlet pipes or hose is blown back through the filter proper, removing all material on the filter surface. In this way the filter can be cleaned in about 10 minutes while it is in operation. Under ordinary conditions, the filter requires cleaning only about twice a year.

A second type of filter made by this same company, which is used in filtering large volumes of air for ventilation, is shown in Fig. 2. This type, known as the panel filter, is supported in a heavy pressed steel frame capable of being mounted in any convenient formation to suit the space available for installation.

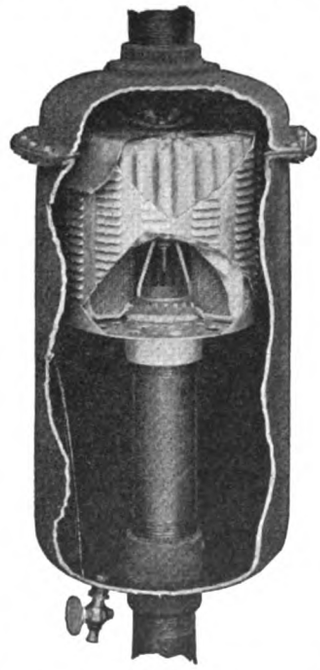

Fig. 1.—Sectional view of Staynew air filter

Fig. 2.—Panel filter unit

The panel consists of two pressed steel or aluminum frames which support a series of hollow fins or pockets formed of wire cloth and arranged in two rows. Each row of fins is covered with a single piece of an extremely fine texture filter material. It is claimed by the manufacturer that this filter has an efficiency of 99.9 percent and that it can be operated under ordinary conditions for several months before cleaning is necessary.

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# Condenser Tubes For Marine Work

## Why tubes fail—Methods adopted to prevent failures—The best tube metal

By Captain C. H. Dinger, U. S. N.

CONSIDERABLE trouble is being encountered with condenser tubes for marine work. Both naval and merchant vessels are experiencing this discomfort. The troubles are varied and so also is the experience on different ships. In some cases the tubes give a satisfactory length of service; in other cases, the tubes last but a short time. The following are some of the representative failures which are experienced.

(a) Local pinhole corrosion. This is experienced on isolated tubes and often there is only one hole in an otherwise sound tube. Sometimes this is caused by a local defect, such as the rolling in of some foreign material. Sometimes also such action is started by the lodgment of a piece of gravel, a small piece of packing, scale, etc., which, being deposited, initiates local action and finally develops a pinhole.

This type of failure is difficult to avoid. Careful inspection of tubes, to guard against any local defect in the surface, and care to see that ashes, dirt, etc., are kept out of condensers may help.

(b) Wearing away of tube ends where they are expanded or packed. This may be caused by too severe treatment of the metal in the packing or expanding operation, whereby the metal, particularly if too hard and not properly annealed, may become changed so that corrosion action at the tube ends is initiated.

The remedy for this trouble is to see that tubes are not too hard and that over-expanding and necking by too severe packing are avoided. The presence of zincs in the water chest, kept in proper metallic contact and frequently cleaned, will also assist in avoiding this action.

(c) Splitting of tubes. This is usually an occasional defect. It is caused by the tubes being too hard or in an unannealed condition. Splitting of expanded ends may be experienced by reason of improper and too rough treatment during the expanding operation.

(d) General pinhole corrosion. This is caused by the salt water on tubes of unsuitable material or by acid-contaminated water on good metal. This action also may be accelerated by the presence of entrained air.

The remedy is to obtain tubes of suitable metal, to avoid contaminated water as much as possible and to avoid conditions that will bring any considerable air into the circulating water. Any churning action and air pockets in the circulating system will tend to increase the air effect. Any measures that tend to create an even flow of water will tend to reduce the effect. The proper venting of water chests may have considerable influence in this matter. In a few installations air-separating devices have been installed to remove the air from the circulating water on its way to the condenser.

(e) General pinhole and wormlike corrosion or grooving effect. This is more or less like that under (d) but the action is probably aggravated by the scouring action of sand, gravel or ashes, which may find their way into the condenser.

(f) Cracking of tubes due to brittleness. This may be caused by the conditions given in (c). Due to cold working and insufficient annealing, there may be present internal stresses causing the tubes to split, both of which are discussed below.

Though such cracking may appear to indicate brittleness, it is not actually caused by brittleness. Apparent brittleness may also be caused by corrosion, especially by dezincification. Brittleness of condenser tubes is not usually caused by chemical composition.

The presence of high internal stress is readily detected by immersing the tubes in a solution of mercurous nitrate. If the stress is high, the tubes so tested crack very quickly. It is claimed that internal stress alone will not cause season cracking, but that corrosion must also be present. If the microstructure shows complete or nearly complete re-crystallization after cold working, season cracking need not be feared.

### Effect of Salt Scale on Tubes

The salt circulating-water will, after a short period of service, deposit a thin gray scale. This, in combination with the zinc oxide, forms a measure of protection, arresting further oxidization. This thin eggshell scale serves as a protection. It is not objectionable and, unless it becomes so heavy as to interfere with heat transfer, should not be removed. However, if the tubes accumulate other foreign matter, the cleaning operation will remove some of this scale. If this happens, it will form again in the course of time.

The chemical action, or corrosion, taking place in the case of unprotected tubes has been, like all cases of corrosion, the subject of a number of theories. The modern view of corrosion, suggested in 1903 by Whitney, may be termed the electrolytic theory. Whitney suggested that since water is an electrolyte it is split up, to a small extent, into hydrogen ions and hydroxyl ions, and the presence of another substance as a catalyst, like the carbonic acid of the old acid theory, is not necessary. According to this theory some of the metal passes into solution in the ionic condition, and an equivalent amount of hydrogen is liberated at the surface of the metal. This liberated hydrogen is depolarized by the oxygen in solution in the water and more metal passes into solution. This action goes on until saturation is reached. A continual supply of oxygen is necessary for the action to continue.

Chemists tell us that the modern electrolytic theory is not sufficient to account for all the phenomena observed, and a modified or auxiliary theory has been brought forward by J. Newton Friend. According to this theory the slowly oxidized metal is formed in the colloidal condition, which, in the presence of air, is oxidized to a higher oxide, still in the colloidal condition. This higher colloidal hydroxide catalytically accelerates the action.



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### Dezincification

The process of dezincification has been the subject of conjecture and a number of theories have been advanced as to the method of the conversion of the metal into a mass of spongy copper. According to the best opinion this phenomenon occurs, especially in salt water, as a result of the setting up of an electrolytic cell between the brass and the copper. The brass, being the anode, dissolves completely and the cuprous chloride, thus formed, is reduced by the zinc in a further quantity of the brass. This produces a red deposit of copper, which then acts as the cathode toward another section of the brass. The action thus becomes more rapid with time, until the whole of the metal becomes converted.

### Protection of Tubes by Means of Film or Light Artificial Scale

The protection of tubes from corrosion has been effected, to some degree, by various artificial deposits of corrosion products, such as oxidation. Other means of affording protection to an appreciable extent are: coating with metals, as tin; coating with varnishes; coating with bakelite; coating with sodium silicate. The coating produced by salt water corrosion may or may not be protective. If this coating is formed under proper conditions so as to have suitable chemical composition and physical properties, it is highly protective. If not so formed, or if continually eroded by the action of entrapped air bubbles, corrosion of the tubes is very rapid. For this reason it has been suggested that condenser tubes, before being put in service, be suitably coated with a film of corrosion products. In some cases the spraying of the interior of the tubes with a light bitumastic solution has been successful in preventing deterioration.

### Operating Features that May Cause Trouble

Operating conditions often may initiate trouble. Condensers should be kept at an even temperature. Allowing them to heat up, because of insufficient circulating-water or the tubes becoming air bound, may help to initiate corrosion as well as to start leakage of the tube ends. When not in use and especially in port where contaminated water is present, the condensers should be kept dry and every means should be taken for keeping out air.

The accumulation of dirt, sea weed, etc. in the tubes may start corrosion, hence the interior of the tubes should be kept clean except for the light gray protective scale that forms from sea water. Zincs in the water chest help to prevent corrosion and they should be kept in good condition with proper metallic contact. They tend to protect the tube ends.

Electric grounds are often responsible for erratic and mysterious corrosion of tubes. This action is usually fairly quick and quite destructive, but when the ground is small the action is not so violent. It is quite essential that the condenser and its connections be properly safe-guarded against stray currents and grounds and an occasional testing out of the system is advisable.

In case of any unusual or erratic action on the tubes, the condenser and its connections should be tested out to see whether it is not grounded in some way.

### Results Disclosed by Examination of Numerous Cases of Defective Tubes

Although these investigations cannot disclose all the conditions incident to the trouble, particularly improper operating conditions, it is an interesting fact that in most cases the tubes that have been found defective in service are also found to be wrong metallurgically. This would tend to show that a very large part of the trouble would be avoided, if the tubes that are installed are metallurgically what they are supposed to be.

The inspection and control of the process of manu facture cannot be too careful. The essential points are:

(a) That the chemical composition is within required limits and that it is uniform and homogeneous.

(b) That the drawing process is properly conducted with regard to annealing, and having the dies in good condition and properly lubricated.

(c) That material is at all stages within the requirements as to hardness.

(d) That defective ingots are eliminated.

(e) That the material presents the desired grain structure when examined metallographically.

At this point it may be well to discuss briefly the methods of making tubes. These are:

(a) The cast-cylinder method, in which a fairly large cylinder of the metal is cast, then reduced by cold working to the size of tube desired. This method is used more than any other, probably because of the amount of labor saved. The product is more likely to be inferior, however, because impurities or flaws may be present on the interior of the cast cylinder and escape attention, causing trouble later on.

(b) The cup and draw method. In this method an ingot of the metal is cast and inspected for any irregularities. After thorough removal of these, the ingot is rolled and punched into the shape of a cup. From this condition it is then cold worked to the size of tube desired. This method of manufacture is somewhat more laborious, but the product is usually satisfactory and worth the additional work and expense.

In both methods it is essential that the amount of reduction during each pass be not too great, and that the work be annealed sufficiently between the various passes.

Seamless monel metal condenser tubes thus far in England have been made by drilling a monel metal forging and then forming tube from this. Experiments are now being made in this country with a view of developing a cupping process for monel metal and present indications are that this will be successful.

There is another method of manufacture of tubes that might be mentioned. The method, known as the Mannesmann process, consists of casting the metal in ingot form, then piercing while the ingot is hot, after which the cylinder thus made is drawn to the size of tube desired. Admiralty metal can not be worked hot, but Muntz metal can, so this method finds application in making tubes of the latter metal. However, as tubes other than of Admiralty metal for condensers and distillers do not give satisfactory service, this method is mentioned merely from the point of view of interest.

Numerous investigations of cases of defective condenser tubes supposed to be made of Admiralty metal in accordance with Navy Specifications show that, in most of the cases, the tubes did not comply fully with requirements. In many cases the chemical composition corresponded to Muntz metal. In other cases the tubes were not properly annealed. In some cases they were too hard. Considerable trouble has been caused by mistreatment of tube ends in packing or expanding.

Pinhole corrosion and channeling or grooving of the interior surface has not been accounted for satisfactorily. The effect of entrained air and methods of

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avoiding its bad effect have been rather baffling. Some improvement may be possible by the use of apparatus for eliminating air from the circulating water. Some actual installations of this kind have been made on Pacific coast vessels.

### The Most Satisfactory Material

The most satisfactory brass material for marine condenser tubes appears to be Admiralty metal made according to Navy Specifications. While there are numerous cases where supposedly Admiralty metal tubes have corroded; there are many cases where they give satisfactory service and many so-called Admiralty tubes are not all that they should be.

Improper operating conditions at some period of a ship's service are often responsible for some defects.

Tubes of monel metal have been used with success in some cases where Admiralty tubes have failed. It is quite evident that monel metal tubes will give very satisfactory service and this service will probably be more reliable and satisfactory than that given by Admiralty tubes, but the cost will be much higher. More experience with monel metal may show in a few years whether it will be cheaper to use monel, on account of longer service, than Admiralty metal. The evidence at hand appears to show that monel metal will have better lasting qualities and can be subjected to more severe operating conditions than Admiralty metal. How much longer they will last we do not know yet. Nickel tubes also should have lasting qualities similar to those of monel metal but at present monel seems to act somewhat better. As monel is likely to be cheaper, there is not likely to be an extensive use of nickel tubes.

Cupro-nickel alloys, with about 70 percent of copper and 30 percent of nickel or 80 percent of copper and 20 percent of nickel, with sometimes a little tin or zinc, are giving a good account of themselves. They are being used to a considerable extent in England and some are in the development stage in this country.

The indications are that they may be an improvement on Admiralty tubes, but until more extensive service experience is secured this cannot be stated definitely. These materials also are somewhat more expensive than Admiralty metal.

Stainless steels are being experimented with. Some will last for a time, but as yet none has given service equal to that of Admiralty metal. It is doubtful whether stainless steel will win out in this field.

### Nickel or Nickel-Alloy Deposit on Brass Tubes

Proposals have been made, and some development work has been done, to produce condenser tubes drawn down from a large tube which has received a coating, inside and out, of non-corrosive metal, such as nickel or monel. If the process can be developed properly, such tubes have promise. They will be cheaper than monel or nickel tubes and not very much more expensive than Admiralty metal. If the nickel coat gives reliable protection, a rather thin brass tube could be used. It might also suffice to have the coating only on the inside of the tubes. The proposal to zinc-plate or lead-coat the inside of condenser tubes has also been made, but as far as is known this has not been tried out. The danger of the coat having holes in it, or wearing off in spots, because of the softness of the coating, would have to be considered.

# What Constitutes a Good Engineer

## An appeal to operating marine engineers to foresee trouble and avert it

By David Gaehr*

DURING the World War some articles appeared in the columns of MARINE ENGINEERING AND SHIPPING AGE, giving a concise impression of what is really expected of engineer officers of the various grades. Yet, the ever-increasing responsibilities marine engineers must bear, because of the more diversified and more complicated equipment placed in their charge, make it quite imperative to call as much attention to the man as to the ship.

Some years ago the *National Geographic Magazine* published a description of the ill-fated dirigible *Shenandoah*, in connection with which the author of the article summed up his estimate of the commander of that airship in these words: "Commander Landsdown is an excellent officer. He foresees trouble and averts it." (Reports have it that he foresaw trouble on his last trip, but subjugated his better judgment to superior authority in that instance, and, hence, was powerless to do any averting.) This characterization of a good officer is, indeed, worthy of frequent repetition and emphasis.

Trouble with mechanical apparatus often involves injury to someone, usually entails loss of time, and sometimes loss of life and property. Hence, it is of the greatest importance for those in charge of machinery to train themselves in constant speculation on what might go wrong and to practice finding a quick solution to meet such an emergency. Particularly is this true in the case of ship propelling machinery, where an interruption in its continuous performance may bring on serious navigating hazards and jeopardize the lives of all on board, especially when the ship is in close quarters, in a heavy sea, or in a swift current.

A good watch officer is never idle. His senses of hearing, sight, smell and touch are all keenly developed. They are capable of noticing water glasses, pressure gages and oil feeds; being aware of the significant pulsations of main engines and auxiliaries and the color of sliding surfaces. The slightest irregularity in any of these indicators arrests his attention and prompts him to investigate, to see whether real trouble is brewing or whether the change is due to some inconsequential modification in operating conditions.

The more complex a machine, or an installation, is, the more opportunities for trouble are present, and the more extensive and thorough should be the knowledge

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of those in charge. They should be more resourceful in finding a way out in case of accident. If anyone ever tests the truth of the old adage, "Necessity is the mother of invention," it is the marine engineer. Many brilliant solutions to puzzling situations have been found by a man in greasy dungarees, under stress of accident. Seldom can a designing, or a constructing, engineer obtain the best operating results with his own "creation;" it remains for the plucky and clever operating engineer to work out refinements and attachments to secure the smooth and efficient operation of the machine.

However, a successful operating engineer's caliber is now gaged quite as much by his ability to obtain the effective co-operation of his "gang," as it is by his ability in the direct handling of machinery.

The characteristics of a good officer, namely, keen foresight, cautious preparedness, recognized leadership, all-around trustworthiness and outstanding ability, are not due to prenatal influences. They are neither hereditary endowments nor Providential gifts, but are developed through conscientious striving after ideals of personal conduct and professional standing. No more striking recognition can be accorded the fortunate possessor of such qualities than in the form of recurring requests, addressed to his employers, for assistants trained under such an officer. No more creditable thing can be said of a "chief" than that he picks his men well, from coal passer up to his first assistant and develops them.

### Retrospection and Outlook

The old school of engineers were close-mouthed for various reasons: (1) Due to the fallacious impression that to divulge important information to understudies would make their own position more insecure, since only by keeping the number of licensed engineers below the demand, would they be in a position to force wage claims; (2) because, though fortunate in the operation of equipment in their charge as though intuitively guided, they realized the need of better knowledge of the principles involved, but did not know how, or were too indolent to "dig out" such knowledge. Hence, they were unapproachable, or ultra reserved, to safeguard their ignorance.

The trend of modern times points to an open-hearted an open-minded relation between engineer officers and their assistants who are willing to do their level best and are willing to be assigned to whatever rank the unrelenting process of the survival of the fittest may decree.

### Sources of Information

It is astounding to see what advances are being made in the free distribution of really valuable and dependable technical information in connection with sales work. Naturally, no particular effort is made to present such welcome information impartially, and it is to be expected that there are "sleepers" in the treatises of this nature, or "sticks" in the sales talk to "pave the way" for an order. Business men are not so unselfish as to distribute a lot of costly educational matter without any thought of returns. Hence, it is for every engineer to acquire that which is good, but show due appreciation for the benefits received. That is good business. Furthermore, it must be conceded that some of these concerns, issuing technical data in connection with trade literature, maintain laboratories, experimental stations and staffs of technical experts superior to those in the foremost educational institutions. They often can shed light on more advanced subjects, in a more thorough manner than the best of textbooks.

Since such information is of little benefit unless digested and reduced to readily accessible form, the engineer must meet the ever-existing need for condensing and systematically recording the most applicable elements of such information.

### Accident Prevention

The "Safety Committees" on board ships have made commendable contributions to the general knowledge of precautionary measures and means for safeguarding life and health and yet, there seem to be so many accidents outside of the realm of those attributed to the "Acts of God," which could have been prevented, but for the fact that someone "did not think."

While the unexpected may happen at any time, bringing to our attention an unprecedented situation, yet, eternal vigilance, coupled with thorough-going knowledge and diligent attention to minor defects, are the most potent means known of averting major troubles.

In all probability the loss of life and property on American vessels would be far greater but for the fact that our Government, through the Steamboat Inspection Service, insists on a conscientious annual inspection of each vessel and upon the thorough test of new equipment to be installed aboard ship.

It is advocated that the engineer frequently read books and reports on "breakdowns at sea," and then return to the never-ending study of the purpose, the construction and proper use of apparatus placed in his charge. He should deliberate in spare moments upon what might go wrong and how to forestall such issue.

It is timely, in spite of all the splendid "safety first" propaganda, to urge incessantly the "humane, and highly profitable, art of accident prevention," stressing care, intelligent and thoughtful procedure in every duty assigned to an engineer. Stress the cultivation of the knack to "foresee trouble and avert it."

Officers should be rated largely by the degree to which they have managed to acquire this art.

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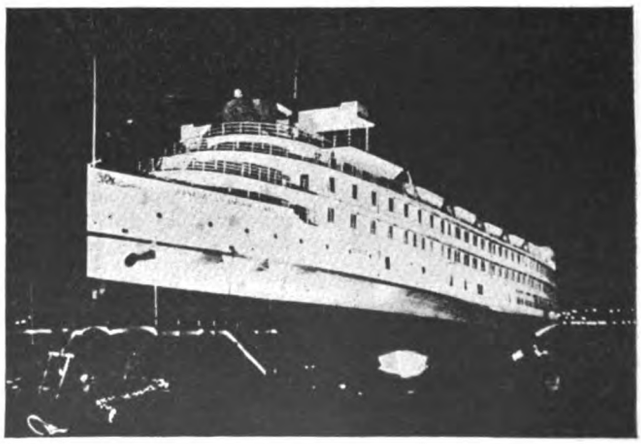
## Floodlight Used for Ship work

The possibility of extending the use of artificial light in the shipyard for night work was recently demonstrated when the steamship *Quebec* was illuminated by a single floodlight with the results shown in the illustration below. Only a single 1000-watt B.B.T. type AF-8 floodlight was necessary to completely light the vessel, which is 360 feet in length.



**Floodlight used to illuminate S. S. Quebec**

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# Machinery of Steamer De Witt Clinton

## Efficiency and co-operation of engine department result in a marked increase in economy

By Charles J. Mason

DURING the summer, the writer made a trip from New York City to Poughkeepsie, N. Y., on the Hudson River Day Line steamer *De Witt Clinton* and, through the courtesy of Mr. Russel G. Siter, chief engineer of the vessel, was permitted to make an extensive visit to the boiler and engine departments. While viewing the engine department, many questions were asked concerning the machinery. All of these were graciously answered by the chief engineer himself. Everything about the department looked so orderly and shipshape, and the machinery ran so smoothly during the trip that it occurred to me that the readers of MARINE ENGINEERING AND SHIPPING AGE would be interested in a brief story about the plant, its operation, and the personnel of the engineers' department. Here was an example of a wonderful co-operative organization that evidently is obtaining results such as the owners of the boat would wish for. We are indebted to Mr. Siter for the following data and descriptions of the plant of which he is in charge:

The *De Witt Clinton* is a twin-screw, passenger, river steamer of 3899 gross tons, built and engined in 1913 by the Harlan and Hollingsworth Company of Wilmington, Del. The vessel operates at an average speed of 20 statute miles per hour. She is one of a fleet of steamers known as the Hudson River Day Line, sailing from the foot of Desbrosses street, New York city, to points on the Hudson River.

### Boiler Plant

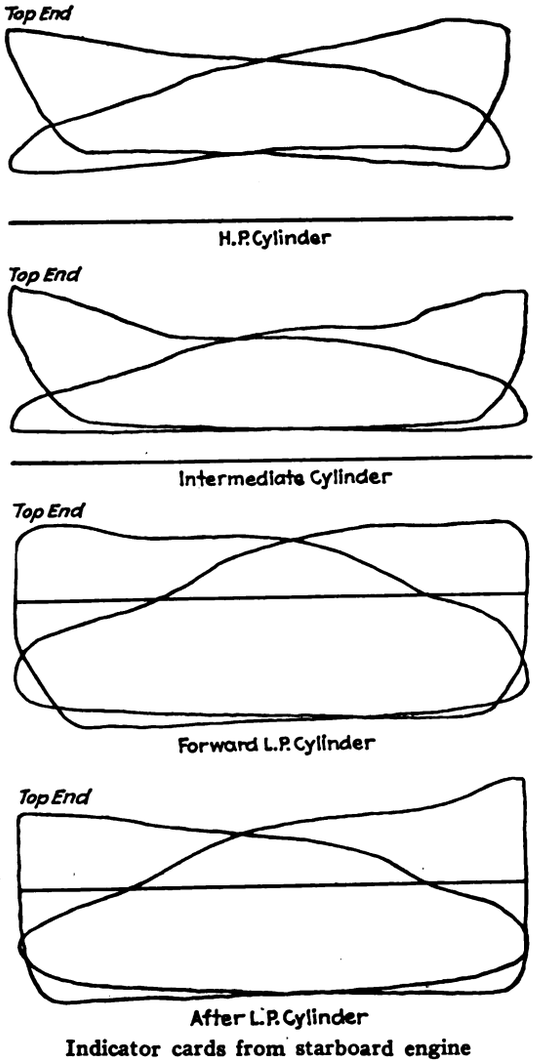
The boiler plant consists of six Scotch boilers, and the usual auxiliaries. Each boiler is 13 feet 6 inches in diameter and 12 feet 3 inches long, and has two furnaces of 52 inches diameter. Dry saturated steam is generated at 185 pounds gage pressure. The feed water enters the boiler at 200 degrees Fahrenheit. Provision is made in the design of the boilers for complete circulation of the water, so that the bottom plates are nearly as hot as are the top plates. The stack draft is carried at 1 inch of water; the Howden closed-ashpit, forced-draft system of combustion is in use.

The boilers are equipped with the Peabody Engineering Company's system of fuel-oil burning, a description of which appeared in the July, 1923, issue of MARINE ENGINEERING & SHIPPING AGE. Above each furnace and at the front end there is a sight glass in line with one of the tubes, by means of which the water tender and firemen on watch can see just how combustion is proceeding in each back connection, and, from the indications, combustion can be controlled accordingly.

All the boiler room accessories and auxiliary apparatus are conveniently located, and under the eyes of the attendants all the time.

### Main Engines

The port and starboard engines (built by the Harlan & Hollingsworth Company) are of the vertical four-cylinder, triple-expansion type, with the cylinders arranged in the following order: One low-pressure cylinder forward, the high-pressure and intermediate cylinders in the center, followed by the second low-pressure cylinder aft. The high-pressure and intermediate-pressure cylinders are equipped with piston valves, and the two low-pressure cylinders have balanced slide valves. The valves are actuated by the ordinary double-eccentric, reversing, link-motion gear. All the bearings are of good design and generous dimensions. No water is used on any part with the exception of the outboard shaft bearings.




**Indicator cards from starboard engine**

### Engine Data

The principal dimensions of the main engines are as follows:

| | | |
|---|---|---|
| Cylinder diameters: | | |
| High pressure | 23½ | inches |
| Intermediate pressure | 37½ | inches |
| Low pressure | 42 | inches |
| Stroke of pistons | 36 | inches |
| Revolutions per minute | 128 | inches |



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The initial steam pressure is carried at 185 pounds per square inch gage. The pressure in the intermediate receiver is carried at 70 pounds gage, and that in the two low-pressure receivers, 14 to 15 pounds gage. Vacuum in the condensers is maintained at 25 inches.

### Horsepower Developed

The total indicated horsepower developed by both port and starboard engines is 4490, approximately 2245 for each engine individually. The total power for the entire steam and electric-lighting plant generated on board totals 5000 in round numbers.

### Independent Auxiliaries

The auxiliaries are all operated independently of the main engines. Air pumps, circulating pumps, feed pumps, steering engine, windlass, fuel-oil pumps, bilge pumps, sanitary pumps, together with three turbine-driven, electric-lighting units, comprise the equipment.

### Economic Performance

The *De Witt Clinton* has covered 13,152 miles on a consumption of 12,007.94 barrels of fuel oil, which (on the basis of 42 gallons per barrel) is approximately 38 gallons per mile run. This includes the operation of all the auxiliaries during the period considered. The fuel-oil consumption per horsepower per hour is a little in excess of one pound.

### Propeller Data

Each propeller has three blades, is 12 feet diameter and has an average pitch of 16 feet 4 inches and a slip of 12.7 percent. The twin screws are right and left hand respectively.

### Notes on Personnel and Operation

The engineers' department consists of a total of 17 men, as follows: Chief, first and second assistant engineers, three junior engineers (two of whom hold licenses), four oilers, two water tenders and five firemen.

The operation and maintenance of the main engines and all the engine room accessories and auxiliaries are in charge of the first-assistant engineer, assisted by the three juniors and the four oilers. The first assistant also takes charge of a watch in the engine room while the vessel is under way, and with him is one junior engineer and two oilers.

The second-assistant engineer has charge of the operation and care of the boilers, and the boiler-room accessories and auxiliaries. In this he is assisted by the two water tenders and the firemen. The second assistant also takes charge of a watch in the engine room during the trip assisted by one junior and two oilers; the chief engineer exercises supervision over the entire department.

### Care of the Boilers

All the boilers are blown down every morning, before the fires are started for the day's run. By this means cleanliness is assured. The boiler room is commodious. It is well lighted, due, in part, to the fact that the boiler fronts and surroundings are painted in light colors. Pleasant surroundings even in the fire room of a vessel are conducive to cleanliness and good care of the apparatus contained therein. This also has a happy effect on the men who have to spend much of their working hours there. In former years the comfort and well-being of a ship's crew gave nobody any particular concern, and the men had to be virtually driven to do the necessary work. All this has been admirably taken care of on the *De Witt Clinton* with satisfying results all round. During my visit in the boiler room the chief jocularly remarked, "We have everything here that is necessary for efficient operation of the plant and for the comfort and convenience of the men, except rugs for the floor, and," he added, "they haven't come yet."

### Overhauling Period

During the winter the boat is "laid up." At that time all the machinery is thoroughly overhauled and renewals and repairs made where found necessary. This work is done by the chief and his crew, practically all of whom are kept on the job.

The plant on this boat is noticeably free of two very insidious evils frequently encountered on board ship; namely, hissing steam leaks and falling "hot drops", and the clatter of out-of-line parts and loose bearings of the machinery.

### Conclusion

Everything in the engineers' department on board the *De Witt Clinton* gives evidence of work well planned and executed, and speaks very highly of Chief Siter and his men, to whom he gives full credit. It is significant that all the men in the department have been associated with their chief for several years, and one in particular has served with him for 10 years. The co-operation which exists among the members of the department, and between the chief and his immediate superior, C. H. Whiton, marine superintendent of the line, is splendid and praiseworthy, and it is bearing fruit in actual practical results as measured in terms of satisfactory service.

The indicator diagrams reproduced with this article were obtained from the cylinders of the starboard engine, and represent graphically the steam distribution in both sets of engines.

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# Prest-O-Lite Flood-Light Attachment

THE Prest-O-Lite Company, Inc., 30 East 42nd street, New York, announces a flood-light attachment of new design for use with the familiar small tanks of dissolved acetylene, the same as are used for truck and tractor lighting.

Flood-light attachment

Prest-O-Lite gas tanks are available from service stations throughout the country. By the connection of the attachment a convenient, portable, powerful flood-lighting unit is obtained which can be used for illumination in dark places and for facilitating night work of all kinds.

The improved attachment is of simple, strong, rigid and compact construction. Universal adjustment is obtained with only one swing joint, thus minimizing the possibility of leakage occurring.

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# Experiments on the Propulsion of a Single-Screw Ship Model*

By G. S. Baker and J. L. Kent

WHEN the details of the stern frame and rudder are under consideration during the design of a single screw steamer, the naval architect occasionally feels the need for guidance in deciding the shape of the screw aperture and the amount of clearance to be allowed between propeller blades and stern frame. The propulsive efficiency of an otherwise well designed ship may be adversely affected by too much weight being given to the practical difficulties of construction and cost of stern frame and rudder post at the expense of good design.

A number of experiments on the efficiency of a self-propelled model of an ordinary type of single-screw cargo vessel have been made at the William Froude National Tank, with the object of investigating the effect on the efficiency of propulsion of a ship when the propeller aperture is partially or wholly closed. In addition, propulsion experiments were made with and without an ordinary plate rudder fixed in position on the rudder post.

The ship model used in these experiments represented on a scale of 1/24.4 a cargo steamer of good average form, with the following principal dimensions:

| | |
|---|---|
| Length between perpendiculars | 400 feet |
| Breadth | 57 feet |
| Draft | 27 feet. |
| Load displacement | 13,350 tons. |
| Block coefficient | 0.76. |
| Trim | Level. |

The model had an ordinary mercantile stern of elliptic pattern, and was fitted with a metal stern frame and rudder post to which could be attached an ordinary plate rudder. The shape and dimensions of the screw aperture are shown in Fig. 1.

The model was propelled by a single four-bladed screw of the following corresponding dimensions:

| | |
|---|---|
| Diameter | 19 feet 5 inches. |
| Pitch | 19 feet 6 inches. |
| Blade area | 132 square feet. |
| Number of blades | Four |
| Outline of blades | Elliptical. |
| Shape of back of blade section | Circular arc. |
| Rake aft at tips | 2 feet 1 inch. |

Two flat metal plates were fitted to the stern frame in such a manner, that the space left in the screw aperture, when the propeller was in place, was almost completely closed. These plates (which were detachable) were of the same thickness as the body post and rudder post, and formed a continuation or extension of the middle line plane. They were chamfered to a fine edge towards the screw and are shown in Fig. 1.

The model was fitted with a stern frame and rudder post of usual type, and experiments were made with the model propelling itself at speeds covering a range of 8 to 13 knots for the ship. During each experiment the torque on the shaft, the thrust and revolutions of the screw, and the speed of the model were automatically recorded. By means of the plates described above the aperture was:

(*a*) Closed forward of the screw and left open aft the screw.
(*b*) Closed forward of the screw and closed aft of the screw.
(c) Left open forward of the screw and closed aft of the screw.

The model was tested in each of these conditions.

It was then fitted with a plate rudder of ordinary type and experiments under conditions (a), (b) and (c) were repeated with the rudder in a fixed fore and aft position. One other set of experiments was made with rudder, stern frame and rudder post removed, so that the model was then in the condition under which model propeller tests are usually made.

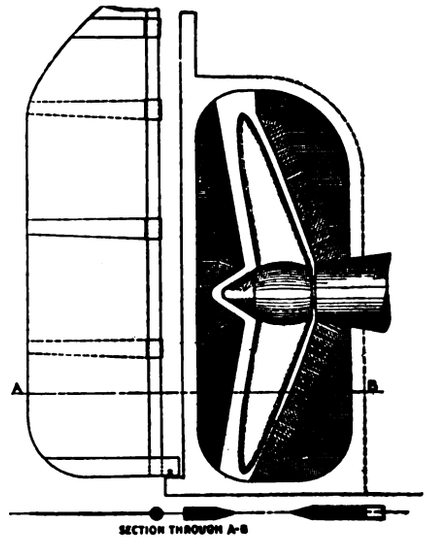


**Fig. 1.—Elevation of stern frame, showing fins and rudder**

## Results

The differences in power required to drive the model under the different conditions of experiment described above are shown in Table I, which gives the propulsive efficiencies obtained by the tests. The propulsive efficiency is the ratio of the effective horsepower of the naked model to the delivered horsepower. That is, the ratio of the power required to tow the naked model to the power delivered on the shaft at the propeller in order to propel the model at the same speed.

Table II gives the equivalent ship propeller revolutions obtained from the model screw experiment values at the point of self-propulsion of the model without correction of any kind.

Tables I and II illustrate the following facts:

*The revolutions of the screw* were diminished by about 3 percent at all the speeds tried when the aperture aft of the screw was closed; the addition of a plate rudder under these circumstances had no effect upon the revolutions. When the fore side only of the aperture was

* Paper read at the spring meetings of the sixty-ninth session of the Institution of Naval Architects, London, March 30, 1928.



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closed, the revolutions were practically the same as with a fully open aperture, but the addition of a rudder in these circumstances diminished the revolutions about 1½ percent at the higher speeds, and left them unaltered at low speeds. With the aperture completely closed the revolutions were diminished at all speeds, although not to the same extent as when the aperture was closed aft of the screw only.

*The propulsive efficiency* of the model was greatest at all speeds tried when the aperture was closed aft of the propeller and open forward. It was least at all but the highest speed when the aperture was closed forward and open aft of the screw, and with the aperture completely closed the propulsive efficiency lay between these two extremes. The addition of the rudder improved the efficiency slightly at the low speeds, and to a greater extent at the higher speeds.

TABLE I.—PROPULSION EFFICIENCIES REQUIRED FOR SELF-PROPULSION OF MODEL

| Speed in knots | | | Aperture. Forward Side. | Aperture. After Side. | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|
| With rudder | With stern frame and rudder post | | Open | Closed | 0.835 | 0.79 | 0.760 | 0.72 | 0.715 | 0.690 |
| | | | Closed | Closed | 0.77 | 0.740 | 0.720 | 0.700 | 0.690 | 0.670 |
| | | | Closed | Open | 0.695 | 0.670 | 0.66 | 0.650 | 0.645 | 0.635 |
| | | | Open | Closed | 0.835 | 0.79 | 0.765 | 0.735 | 0.715 | 0.680 |
| | | | Closed | Closed | 0.755 | 0.725 | 0.705 | 0.690 | 0.670 | 0.640 |
| | | | Closed | Open | 0.690 | 0.665 | 0.655 | 0.640 | 0.610 | 0.570 |
| Without rudder | Without stern frame and rudder post | | Open | Open | 0.780 | 0.725 | 0.690 | 0.670 | 0.650 | 0.605 |

$$\text{Propulsive efficiency} = \frac{\text{E.H.P.}}{\text{D.H.P.}} = \frac{\text{Tow-rope horsepower of naked model}}{\text{Horsepower delivered to screw to self-propel the model}}$$

TABLE II.—REVOLUTIONS PER MINUTE OF SHIP PROPELLER AT DIFFERENT SPEEDS

| Speed in knots | | | Aperture. Forward Side. | Aperture. After Side. | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|
| With rudder | With stern frame and rudder post | | Open | Closed | 44.0 | 49.7 | 55.4 | 61.1 | 66.8 | 73.1 |
| | | | Closed | Closed | 44.4 | 50.1 | 55.9 | 61.7 | 67.5 | 73.3 |
| | | | Closed | Open | 45.6 | 51.4 | 56.9 | 62.5 | 68.0 | 74.4 |
| | | | Open | Closed | 44.0 | 49.7 | 55.4 | 61.1 | 66.8 | 73.1 |
| | | | Closed | Closed | 44.8 | 50.6 | 56.4 | 62.2 | 68.0 | 73.9 |
| | | | Closed | Open | 45.6 | 51.4 | 57.2 | 63.0 | 68.8 | 75.6 |
| Without rudder | Without stern frame or rudder post | | Open | Open | 45.1 | 51.3 | 57.3 | 63.3 | 69.3 | 75.7 |

$$\text{Ship propeller revolutions} = \frac{\text{Recorded model revolutions}}{\sqrt{\text{Scale } \frac{\text{ship}}{\text{model}}}}$$

The extent of the gain in propulsive efficiency obtained by closing the aperture aft of the screw over that when the aperture was wholly open can be illustrated by the fact that from 7 to 11 percent less power was required to drive the model in the former case than in the latter.

## Conclusions

These results indicate that:

(1) A fin fitted to the stern frame forward of the screw is disadvantageous, although a slightly better result than that given in the paper might have been obtained if the extra length of after body given by the fin plate had been used to ease the after waterlines near the top of the aperture—provided this were done with a really good tapered finish, and not with the usual post-ending having a blunt half-siding of 4 or 5 inches.

(2) Fitting a fin plate on the fore side of the rudder post was a distinct advantage. To obtain the full benefit from it this fin must be fitted close up to the after edges of the propeller blades. The rudder itself has the same action as this fin plate, but it is too far from the screw for it to be very effective. Other tests made with the fin having a clearance of about 6 inches from the propeller blades have shown improvements of about two-thirds that given in the paper.

It would appear to be advisable to extend the rudder post as shown in Fig. 1, but if this is done by the addition of vertical plates they should be fitted flush with the rudder post and be tapered or rounded at their forward edges. In addition, the finished fin should be rigid and of solid construction, firmly attached to the rudder post and hull in order to avoid all possibility of vibration.

Although no steering experiments were made on this model, other experiments, made on similar models and described elsewhere, indicate that the turning moment on the ship is increased by the addition of a fin to the rudder post and the torque on the rudder stock unaltered.

In the same way a small but definite gain in steering efficiency is obtained by closing up all the gaps between the rudder post and rudder stock, and the best propulsive and steering conditions would be obtained if this were done in conjunction with a closed aperture aft of the screw.

The experiments themselves do not demonstrate the reason for the improved or lower efficiency with the aperture blocked. Observations of the appearance of the "race" can be very misleading; but it was noticed that when the aperture was closed the race was central, and immediately after the removal of the after-aperture plate it moved to one side a little. One other certainty can be stated, viz. that the surface of the fin being fore and aft cannot accept any thrust—in other words, there is no thrust return obtained from the action of the "whirling" race on these fins.

A number of minor facts have appeared in the course of our work on propeller theory and tests, and the authors venture to put forward the following opinion as one which at least explains these facts and does not contradict any other known ones.

There is whirling in the propeller race, and this is most emphatic on the center line. The whirl must tend to develop within the screw, but the after fin does not allow it to develop to the same extent as before, and compels the water to move fore and aft. There is,

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consequently, better conservation of fore and aft momentum, and less loss in whirling or spiral motion. Above the propeller race there are eddies with horizontal and vertical cores, and considerable cross-flow from one side of the ship to the other. This cannot take place to the same extent with the fin in the aperture, and the flow in this region becomes more stable and consequently less wasteful.

This opinion being accepted, it follows that the fin may take any form as long as it performs the function of a fin without involving any extra resistance.

### Propeller Blade Sections with Aerofoil Shapes, Working at High Slips

In the paper read in February 1927 before the North-East Coast Institution of Engineers and Shipbuilders,* it was stated that propellers having the backs of the blades of aerofoil sections gave better results than those with plain circular back sections under certain slip and thrust conditions. Results obtained with blades in an air channel suggest that at high slips an aerofoil shape would have no advantage, and might be disadvantageous. Although the nominal slip on this hull is quite low, the actual one, taking the wake into account, is fairly high.

In order to decide the relative merits of the two forms of propellers, a new screw (AK) was made of precisely the same dimensions and similar blade outline to that used in the experiments described in this paper (V), with the exception that the blade sections were of approved aerofoil shape instead of circular arcs.

A series of experiments have been made with this propeller (AK) fitted to the same ship model described in this paper, with an open aperture, and a comparison of the results obtained with each screw is given in Table III.

These results show a fairly steady gain for screw AK, accompanied by slightly lower revolutions. Both screws show the same falling off of efficiency at high speeds when the turbulence is greater. The tests at different speeds represent nearly the same nominal slip conditions, and other results obtained suggest that at higher slips the aerofoil screw would lose its advantage. The gain in efficiency is somewhat greater than was expected from previous experience; but the model was a good tank form, and presumably the conditions were such that the aerofoil propeller could show to fullest advantage.

TABLE III.—COMPARISON OF RESULTS WITH MODEL PROPELLERS V AND AK

| Speed in Knots | Quasi-propulsive Efficiency | | Revolutions per minute | |
|---|---|---|---|---|
| | Screw V | Screw AK | Screw V | Screw AK |
| 8 | 0.780 | 0.83 | 45.1 | 43.7 |
| 9 | 0.725 | 0.76 | 51.3 | 49.6 |
| 10 | 0.690 | 0.725 | 57.3 | 55.3 |
| 11 | 0.670 | 0.72 | 63.3 | 61.1 |
| 12 | 0.650 | 0.70 | 68.3 | 67.0 |
| 13 | 0.600 | 0.65 | 75.7 | 74.4 |

*Vol. XLII., Part 4, p. 153, January-February, 1927. By G. S. Baker.

# Bending and Loading of Ships*

## Derivation of load factor in standard formula† for determining maximum bending moment to be expected in general service conditions

By J. Foster King

IN order to settle, if possible, the relationship between calculated bending moments and variations in form and displacement, a complete series of wavecrest calculations were made under apparently ideal conditions, where the curves of load and displacement in still-water were identical in form and area. In order to cover as much ground as possible, three widely different types of model were selected, of which the midship sections are shown in Fig. 1.

Y had rectangular sections, angular waterlines, and a midship section coefficient of 1.0.

S1 had modern lines, a midship section of 0.975 coefficient such as is now found over a wide range of *c* values.

S2 had old-fashioned fine lines, hollow at ends, and a midship section coefficient of 0.84.

The lines of each model were pulled about, in order to cover *c* values between 0.5 and that of its midship section coefficient, their still-water displacements were considered in relation to those on ordinary trochoidal waves which had a length = L and a height = 0.05 L, first with the crest amidships and second with the hollow amidships.

Under the assumed conditions, the curves of load and of stillwater displacements are the same; the centers of gravity of the half-displacement in still-water there-

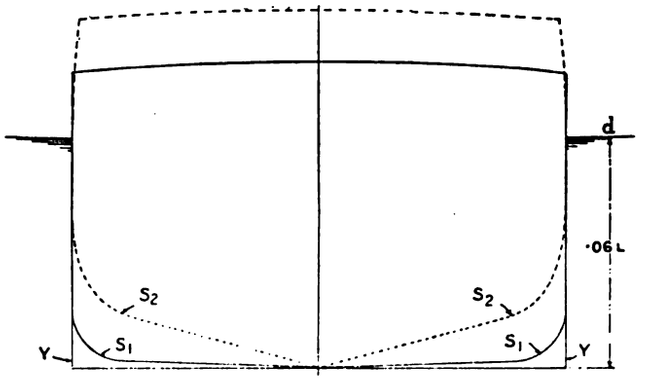


**Fig. 1.—Midship sections of models**
Y=1.0 midship section coefficient; $S_1$=0.975 midship section coefficient; $S_2$=0.84 midship section coefficient.

fore coincide with the centers of gravity of the half-load on each side of the center of buoyancy, and there is no bending moment. The position of the centers of gravity of each wave half-displacement travels towards amidships as the crest travels to amidships, and towards the ends as the crest travels to the ends. The bending moment at the center of buoyancy (which is

* Paper read at the spring meetings of the sixty-ninth session of the Institution of Naval Architects, London, March 28, 1928.
† L × B × *d* ÷ 35 × 0.0215 L. Throughout the paper: L = length, B = molded breadth, *d* = molded draft, *c* = block coefficient of fineness, Δ = displacement.

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also the center of gravity of the load and displacement areas) is the difference between the original, still-water positions of the centers of gravity of the respective half-displacements, and those of the wave half-displacements multiplied by $\frac{\Delta}{2}$. This corresponds to the mean of the distance traveled on each side, multiplied by $\frac{\Delta}{2}$, or alternatively the half-travel multiplied by $\Delta$. The accuracy of this proposition as a measure of maximum bending effect has been tested, not only by comparison with calculated cases but by means of calculated moments for a model of which the after half was oblong and the other half was a wedge.

The mean positions of the centers of gravity of the half-displacements in still-water are very near each other in all three models, and it may sometimes be convenient, when full information is not available, to know

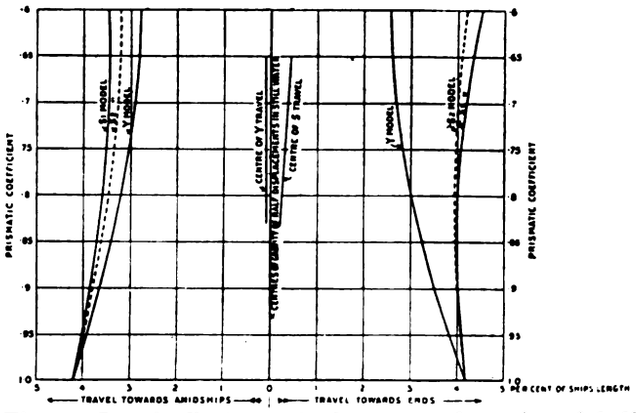


**Fig. 2.—Longitudinal travel of centers of gravity of half-wave displacements about centers of gravity of half-displacements in still-water**

that the mean positions for ship forms lie near a straight line joining 0.18 L at 0.65 and 0.21 L at 0.83 prismatic coefficient.

Fig. 2 shows, for the three models Y, S1 and S2, the mean travel towards and away from amidships of the centers of gravity of the wave half-displacement areas, in relation to the still-water positions of the center of gravity of the half-loads. The Y models have vertical sides all fore and aft, the wave travels shown are for a draft corresponding to 0.06 L, and, being expressed as a percentage of the length, are applicable to any length of ship. As the models have vertical sides, the displacement area in way of the wave contour at each coefficient, is constant at all drafts; the area below the wave contour therefore causes the travel of the center of gravity of the half-wave displacement, to vary inversely as the draft; the resulting bending effect at each coefficient is therefore derived from a constant percentage of L at all drafts greater than are sufficient to accommodate the wave profile, or than 0.023 L at 1.0 coefficient and 0.033 L at 0.5 coefficient. The midway position between the Y curves for hog and sag travel lies on the hog side of the centers of gravity of the hull half-displacements in still-water, so that the ideal position for each center of gravity of half-load is not at but nearer amidships than the centers of gravity of the still-water displacements, as shown on Fig. 2. As the mean travel multiplied by the half-displacement gives the actual bending moment, it follows that the travel multiplied by the coefficient of displacement is a comparative measure of bending effects. Within the range of practicable ship coefficients (say 0.6 to 0.83) Y curves indicate that the bending effects tend to vary as the square of the coefficient.

Models S1 and S2, as used in Fig. 2, have geometrically the same model as at their original design draft, but their drafts have been increased inversely as their midship section coefficients, so that at the same prismatic coefficients as the Y models they have the same displacements.

The effect of the curvilinear forms of ship models and of their varying slope in way of the wave contour, causes the travel of the centers of gravity of the half-wave displacement areas to be distinctly greater than in the case of the Y models. The travel also becomes relatively greater as the models become finer, so that the tendency of the bending effect changes from a variation of the order of the square of the coefficient to one of the order of directly as the coefficient. It also transfers the ideal positions of the half-load centers of gravity to the other or sag side of the still-water centers of buoyancy, as shown in Fig. 2 for the S models. In spite of the great difference in form between models S1 and S2, it is apparent from Fig. 2 that, in way of the wave contour, at design draft and equal displacements, there is such geometric similarity in form as prevents any wide difference in their respective ranges of travel. Absence of "tumble-home" and presence of good flare, however, have the effect of increasing the travel in the hog and sag directions respectively, and vice versa. For each of the ship models the curves of area of wave half-displacements at each coefficient are of geometrically constant form at the design draft, so that, like the Y models, the bending effect of travel is a constant percentage of the ship's length for all models which are geometrically similar.

So long as the draft is great enough to keep the wave contour well away from rapid "fining" of the bottom, the bottom form has no importance and, under the conditions taken, the midship area coefficient has no appreciable effect upon the travel.

Fig. 2 shows that the travel curves for all forms of midship section have a common origin at 1.0 prismatic coefficient, and it has been shown that the resulting bending effects for each prismatic coefficinet are *constant* at all design drafts. It follows when the travel curves for models whose midship area coefficient is less than 1.0 are expressed in terms of constant molded draft and varying block coefficients of fineness that the origin of travel for each model is on a line, the travel of which varies inversely as the midship-area coefficient. It was found that, with a molded draft corresponding to 0.06 L, the travel curves for the S2 or fine models were nearly parallel to those for the Y models, and that the curves for the S1 or moderate models swung out from their origins near Y to meet S2 about 0.5 coefficient. Midship area coefficients of the order of 0.84 (S2 model) are now used with none but very fine models, and those of the order of 0.975 (S1 model) cover a wide range of coefficients, but the whole range to 1.0 can only be covered by midship area coefficients which also reach towards 1.0. It was found that the Y curve swung outward about its origin, at 1.0 coefficient, to the position occupied by the fine model (S2) at its own coefficient complies with the foregoing description of the average relationship between midship area and block coefficient, and can be accepted as an almost perfect picture of the travel induced by wave-form displacements on ordinary modern models of all

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coefficients of fineness, at the investigated draft of 0.06 L.

Fig. 3 shows these curves (S) for d = 0.06 L in comparison with curves Y, which are the same as on Fig. 2, because the block coefficient of fineness is also the prismatic coefficient.

For the reasons given in connection with the travel curves on Fig. 2, i.e., the geometric similarity of the curves of displacement area for each model at the design draft, it follows that the bending effect of travel

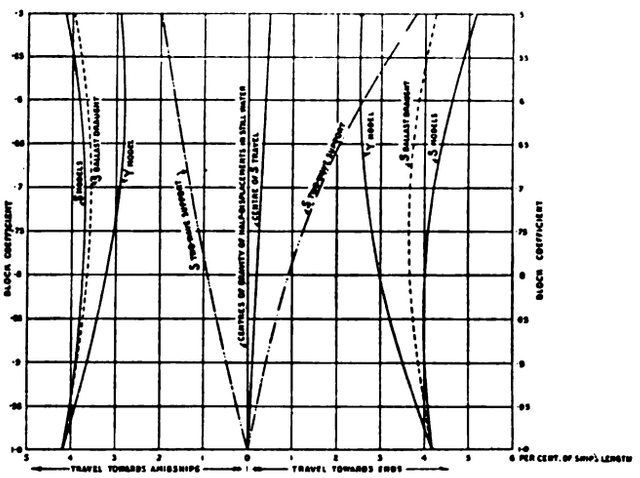

**Fig. 3.—Longitudinal travel of centers of gravity of half-wave displacements about centers of half-displacements in still-water**

is again measured at that draft by a constant percentage of the ship's length at each value of *c*.

S curves travel farther on the sag than on the hog side, and the mean or "ideal" position for the centers of gravity of the half-load areas in still-water for the average models lies outside the positions of the half-displacement centers by an amount which is expressed by $\frac{(1-c)L}{100}$. The total travel at 0.5 coefficient is only 12 percent greater than that which would show bending effects that vary as the displacement at the designed draft.

An investigation was made to ascertain the effect upon travel when the draft of the *same* models is reduced to two-thirds of their designed draft. The ascertained travels were corrected for displacement, so that bending effects could be directly compared with those at the original draft. The corrected travels are shown by the dotted lines marked "S ballast draft" on Fig. 3. The total travel for S1 model is such that with nearly 35 percent less displacement the mean bending effect has only been reduced 8 percent from that at the designed draft, but the actual *distance* traveled is 42 percent greater, and the ideal position is still on the sag side of the travel.

Observed facts show that there must be some other factor in the problem, and a series of calculations was made in order to ascertain the effect of supporting the models on two waves of the same height but half the length of those previously used. This condition is so much nearer probability than that of the "single-wave" estimates, that it might have been reasonable to double the ascertained travels as a comparative measure of their effect. They have, however, been shown on Fig. 3 by the lines marked "S two-wave support" as actually calculated for average ship forms. Their travel and corresponding bending effects increase so rapidly from zero at 1.0 coefficient that the lines are no less than two-thirds of the way to the single-wave travel at 0.5 coefficient. They give, therefore, a surprising confirmation of my disbelief in "fineness of form" as a qualifying factor in dynamic stress. This line of investigation was not pursued, partly because it is only one of an infinite number of possible assumptions, but chiefly because it commences with *no* moment at amidships with 1.0 coefficient. The latter fact, however, has to be considered

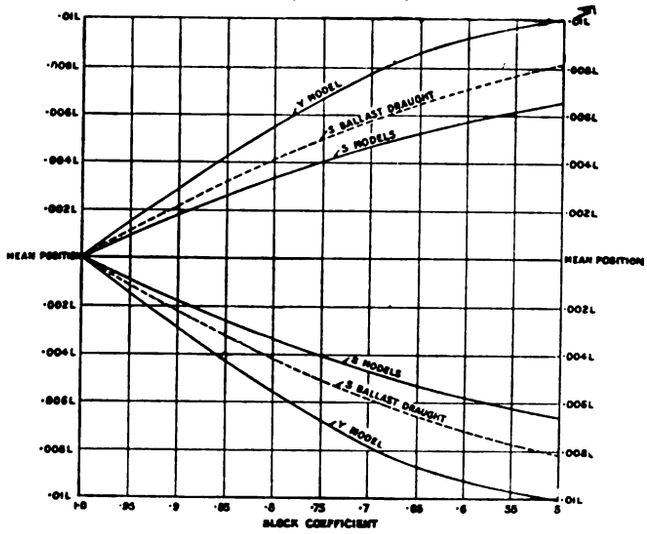


**Fig. 4.—Vertical travel of waves**

in relation to the other fact that severe bending stresses do travel along the midship half-lengths of ships, because under the assumed conditions the maximum bending moment at 1.0 coefficient takes effect at the quarter-length from each end.

Reverting to the original "wave-crest" calculations as a comparative measure of dynamic effect of wave forms of displacement, it has to be observed that their use has hitherto been restricted to a measurement of the longitudinal movement of the centers of gravity of the half-displacements about the centers of gravity of the half-loads. There is, however, a vertical movement of the wave displacements, additional to and concurrent with the longitudinal movement, which seems to require consideration as a factor in any static basis for a comparative measure of dynamic effects.

Fig. 4 shows the calculated extent of these vertical movements for the Y and S models in terms of *c*, at design and ballast draft respectively. It will be seen that this travel starts from zero at 1.0 coefficient it corincreases as *c* diminishes, until at 0.5 coefficient it corresponds to 0.013 L for S at design draft, 0.016 L for S at ballast draft, and no less than 0.02 L for Y models. The magnitude of the movement in the Y models is consequent upon their sides being vertical; for that reason the movement of the ship models increases as their draft decreases, because the mean form of the sides in way of the wave contour is at the same time coming nearer to the vertical, an effect which is shown by the curves marked "S ballast draft." The effect of the potential vertical movement of wave displacement on ship forms might be expressed as a bending moment in similar fashion to that of our expression of the effect of the potential longitudinal movement. Its value might reasonably be measured by the layer of displacement contained between the middle and the top or bottom of the total travel, multiplied by the mean distance of the

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centers of gravity of the half-waterplane areas, from the center of gravity of the whole waterplane.

Fig. 5 shows such bending effects added to those for longitudinal travel expressed by S curves on Fig. 3. This sum of vertical and longitudinal effects, as shown by lines $x$, lie very near to those for the "standard" bending moment, which are also shown on Fig. 5. This result was not forseen, but the evidence of full-scale experiments justifies the form of $x$ as a sound basis for a comparative measure of wave effects, and also indicates the wisdom of providing the small margin of safety which is afforded by varying the rate of travel inversely as the coefficient.

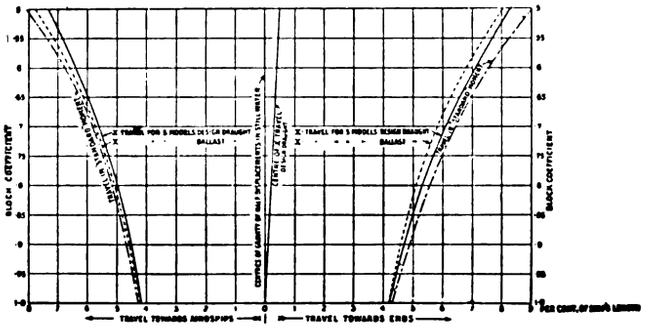

**Fig. 5.—Combined longitudinal and vertical travel effect**

The $x$ curves for "ballast draft," which are also shown on Fig. 5, seem to show that, for drafts less than the design draft, no greater modification should be made than is due to the shift of the ideal position for the half-load centers towards that for the half-displacement centers.

The present analyses of the double movement show that where the lower part of the model is "fined" and the upper part "filled out," any gain in restraint of vertical movement is lost in increased longitudinal movement, and that converse operations produce converse results. It is therefore difficult to see what useful purpose can be served by making particular wave-crest calculations for particular models, in order to estimate unknown dynamic effects.

Turning to the practical application of these investigations, it is obvious that any other series of assumed wave forms will produce other percentages of the ship's length as measures of wave travel, but experience seems to prove that the $x$ curves are a more severe measure of the movement of wave-displacements past load centers, than is necessary for good service conditions, because the direct use of $x$ travels would obviously restrict the position of the centers of gravity of the half-loads to that which coincides exactly with the ideal position, or midway between the travels of the half-wave centers of gravity. Experience also shows that the "Smith" correction (which is, in effect, a modification of wave contour) has justified its use. The effect of this modification is stated by Sir John Biles to represent a reduction of about 12 percent from the total bending moment derived from the unmodified wave contour, a reduction in total effect of load and wave travel which means a larger reduction in the constant travel effect of the half-waves alone. Experience also indicates that the "standard" bending moment (which corresponds to a travel equal to 0.043 L in the nomeclature of the diagrams) provides a sufficient margin to cover a movement of the half-load centers of gravity on either side of the ideal position, which is of the order of 0.01 L. It seems safe, therefore, to deduct 0.01 from the standard figure of 0.043 L and to use 0.033 L at 1.0 coefficient as a sufficient measure of the constant bending effect of wave travel about the *ideal* position for the centers of gravity of the half-loads, which, as already shown, lies outside the position of the still-water centers of half-displacements by an amount which corresponds to $\frac{(1\text{-}c)L}{100}$. For use with the whole displacement, 0.033 L becomes 0.0165 L.

As the derivation of a load factor in the "standard" formula was the chief object of this investigation, it appears to me, on the evidence of observed facts and of the investigation, that a satisfactory expression of present knowledge will be given by the following adjustment of the "standard" formula:

Where the designed drafts bear a reasonable proportion to the length of the ship, and the total distance between the centers of gravity of the half-load situated on each side of the true center of buoyancy is equal to the total distance between the centers of gravity of the still-water half-displacements on each side, plus a distance equal to $\frac{(1\text{-}c)L}{50}$, the constant bending effect of wave travel at the designed draft is found from the formula, $L \times B \times d \times 0.0165L \div 35$, i.e. the parallelepipedon displacement $\times$ 0.0165 L.

Where the whole distance between the centers of gravity of the half-loads is *greater or less* than that defined above for the ideal position, the factor 0.0165 is to be *increased* by the amount derived from the following formula:

$$\frac{\text{Difference in distance}}{4L} \times \frac{\text{Actual draft}}{\text{Design draft}} \times c$$

The presence of draft and coefficient in the second or load effect portion of the formula is required because the load effect of travel varies directly as the displacement and the formula as applied gives a modification in the direction indicated by the investigation at two-thirds of the designed draft. The formula has been tested over a wide range of known cases, and gives results which harmonize more closely with observed facts than those given by the classic "wave-crest" calculations.

As the formula deals only with known conditions which are easily ascertained at designed and light drafts, it enables builders to supply owners with guidance as to permissible dispositions of cargo and ballast, without having resort to complicated calculations. This in itself would be an immediate, definite contribution to the safe handling of ships, while the tangibility and relative facility of application of the method present opportunity for the expansion of knowledge of the true relation between the formula and the facts of service conditions. It would be a comparatively simple matter to provide ship masters with information and material which would enable them to record facts as to dispositions of load in relation to positions of centers of gravity, and of their effects at sea.

# Launching a New Ship's Bow

THE new fore-end to replace the damaged fore part of the Royal Mail motorship *Lockmonar*, was launched recently at the plant of Harland & Wolff, Ltd., Belfast, Ireland. During the latter part of 1927, this vessel ran ashore on the Mersey Revet-

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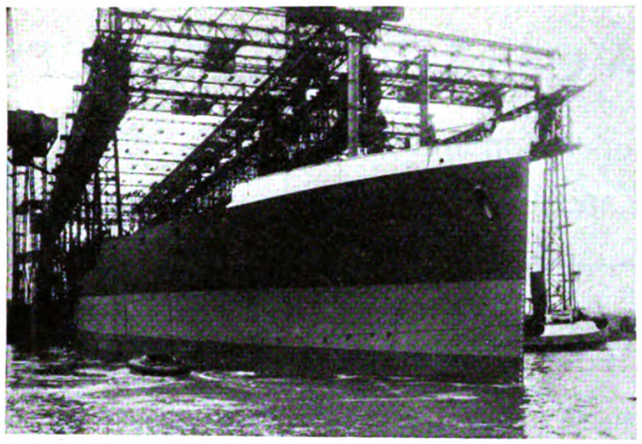

**Launching of the bow section**

ment and was so badly damaged that, in order to salvage her, it was necessary to cut off about 150 feet of the fore end of the vessel. A temporary bulkhead was erected and the after part of the ship towed back to Belfast where she will be placed in dry dock and the two sections joined together.

The *Lockmonar* is a vessel of 9400 gross tons and is 485 feet in length. She was built in 1924 by Harland & Wolff, Ltd., and is propelled by Burmeister & Wain Diesel engines. The new bow portion is 175 feet in length.

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COMMERCE IN AMERICAN VESSELS.—In the five months ended with May, American flag vessels carried 34 percent, by value, of domestic exports and 32.2 percent of general imports of the United States in foreign trade, according to the monthly summary of foreign commerce issued by the Department of Commerce.

# Floating Dry Dock Launched

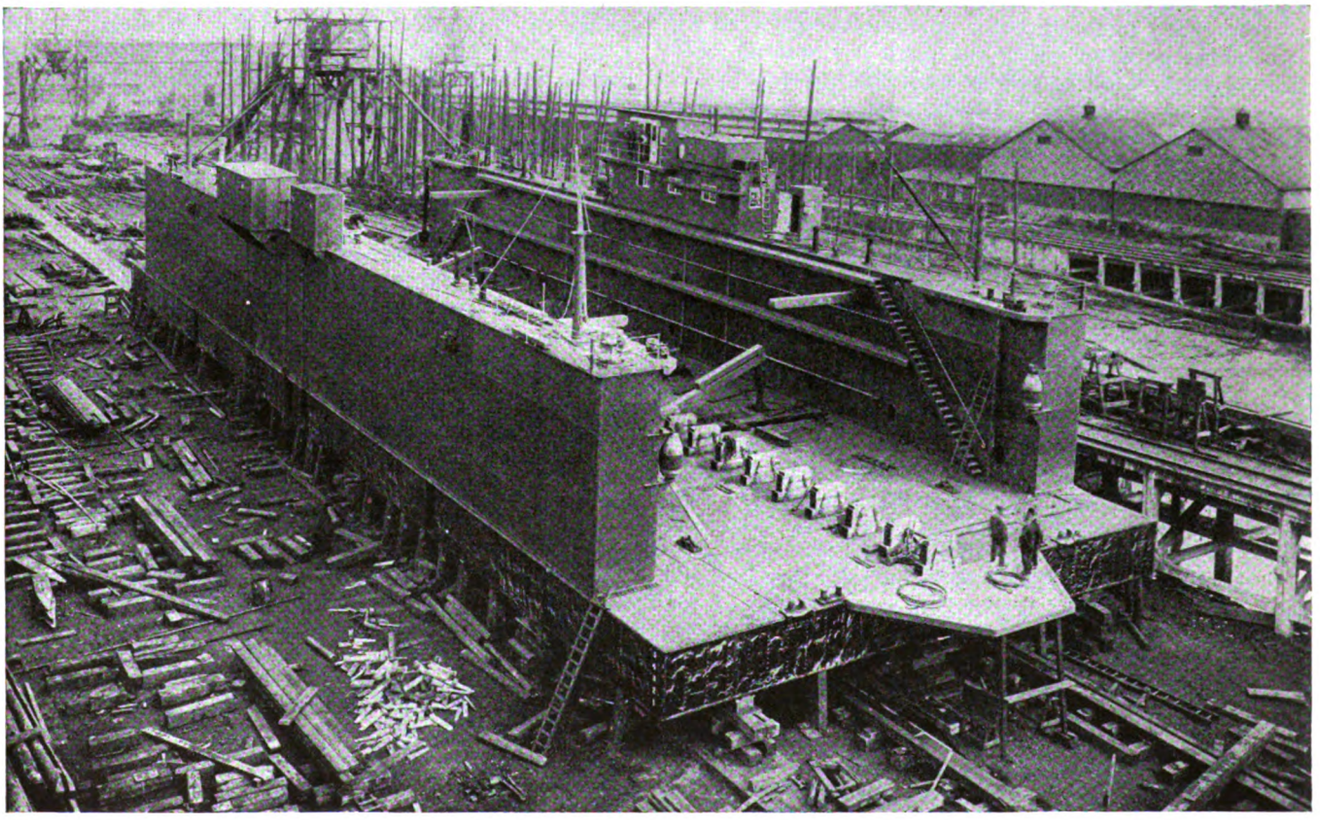
A STEEL, self-docking, floating dock built for the British Tanker Company, Ltd., London, was recently launched at the Newcastle-on-Tyne yard of Sir W. G. Armstrong Whitworth & Company. The principal dimensions of the dock are:

| | | |
|---|---|---|
| Length over platforms | 194 feet | 0 inches |
| Length over pontoons | 172 feet | 11 inches |
| Overall width | 61 feet | 3 inches |
| Clear width between fenders | 44 feet | 6 inches |
| Overall depth of pontoons | 5 feet | 10 inches |
| Length of each of four pontoons | 41 feet | 8 inches |
| Space between pontoons | 2 feet | 1 inch |
| Overall length of side walls | 152 feet | 1 inch |
| Overall height of side walls above edge of pontoon | 19 feet | 7 inches |
| Overall width of side wall | 6 feet | 3 inches |
| Draft of water over keel blocks | 12 feet | 6 inches |
| Corresponding freeboard of side walls | 3 feet | 8 inches |
| Height of keel blocks | 3 feet | 0 inches |
| Depth of water required at site | 22 feet | 0 inches |
| Time of lift (Vessels of 600 tons, 10 feet draft) | 2 hours | |

The dock is capable when floating in fresh water of lifting and carrying a vessel displacing 750 tons.

The pumping machinery consists of two horizontal, vertical-spindle type centrifugal pumps driven through bevel gearing by semi-Diesel type engines. These units are located on top of the main drain which runs along the bottom wall of the dock. In addition, a centrifugal pump having a capacity of 150 gallons per minute is installed in the starboard wall for fire service.

The dock was constructed to the designs of Clark and Standfield of London, England, and the work was carried out under the supervision of this firm.



**Steel self-docking floating dock built by Sir W. G. Armstrong Whitworth & Company for the British Tanker Company**

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# Questions and Answers for Engineers

## Practical information on the operation and maintenance of boilers, engines and auxiliaries

*This department is maintained to help those who desire practical information regarding engine room problems or who are preparing to take examinations for a marine engineer's license. Readers are urged to send in questions. Inquiries bearing the name and address of the writer will be answered promptly by mail. If the question is of general interest the answer will also be published in an early issue of the magazine, although the identity of the writer will not be disclosed in doing so. Anonymous communications will not be considered.*

### Steam Pressures for Turbines

Q.—Explain why it is better to carry a high steam pressure in a turbine.

A.—Every endeavor should be made to carry the steam pressure in the high-pressure belts at as high a point as the boilers can deliver the steam, for the higher the steam pressure, the greater the steam expansion, with a consequent increase in the number of heat units derived from the steam.

### Pitch of Propeller

Q.—In obtaining the pitch of a propeller what three measurements are necessary?

A.—(1) The radius at which the pitch is measured. (2) The angle or part of the complete circumference corresponding to the distance on the blade between the two points between which the pitch is required. (3) The advance parallel to the shaft line, corresponding to this part of a complete revolution. These measurements are obtained by means of the pitchometer.

### Operation of Finger Plate on a Turbine

Q.—Describe the principle of operation of the finger plate on a turbine.

A.—The principle of operation of the finger plate is the same on all turbines. It is used to indicate at a glance the position of the rotor. It is securely fixed on the bearing support. One end of it projects into a groove on the rotor shaft and represents the position of all rows of stationary blades. The sides of the groove in the shaft represent the edges of the adjacent rows of moving blades just forward and just aft of the row of stationary blades represented by the finger plate. The finger plate is so fitted that the distance from its after edge to the after edge of the groove is exactly equal to the clearance from the stationary blades aft to the moving blades. The distance from the forward edge of the finger plate to the forward edge of the groove exactly represents the clearance from the stationary blades forward to the moving blades. Therefore, to get the exact clearances it is only necessary to insert feelers between the edges of the finger plate and the edges of the groove. This measurement can be taken only when the rotor is stopped, but can be approximately judged when the shaft is revolving.

### Removing a Propeller

Q.—How would you proceed to take off the propeller on a single-screw ship?

A.—Install a shore between the after shaft coupling and the forward side of the stern tube to prevent strain on the thrust or main bearings, then remove the propeller nut. Fill the space between the propeller hub and sternpost with metal blocking and a pair of metal wedges, placing one set of the wedges on top of the shaft and the other underneath. Then drive, from opposite sides, one wedge of each pair.

### The Eccentric

Q.—Explain how motion is generally imparted to a slide or piston valve.

A.—By means of an eccentric, which is a circular cast steel sheave having a hole bored in it eccentrically with its own circumference, and large enough so it can be fitted on the shaft. This eccentric sheave is either keyed or held in place by set screws on the shaft. On the circumference of the eccentric which is wide enough to present a good bearing surface, the eccentric strap works and attached to this strap is the eccentric rod, which is either directly connected to the valve rod or else imparts motion to the valve through the agency of the rocker arm or link gear. The center of revolution of the eccentric being several inches apart from its center of formation will, when the eccentric revolves with the shaft, cause the eccentric to convert the rotary motion into a reciprocating motion, which through the agency of the rod is imparted to the valve.

### Dismantling a Set of Gears

Q.—Give several important points that should be noted when dismantling a set of gears.

A.—The gear cases are split horizontally for the easy removal of the gear case, and are provided with eyebolts for the attachment of slings. When handling parts, avoid damage to the gear teeth, shafts, thrusts and bearings. Avoid damage to all joint surfaces. Prevent the forming of burrs or ridges that would result in oil leakage. When removing bolts, nuts, screws and other small parts, mark them to avoid delay in reassembling. Place them in some receptacle, for safe keeping, and clean them thoroughly before replacing. Remove all oil-pressure gages and piping to the gear that will interfere with lifting or is liable to be damaged. Drain all oil from the gear case and pump it from the drain tank to the settling tank. Close all pipe openings with wooden plugs, or tie canvas over them; never use waste for this purpose. Rest the pinions and gears on wooden blocking. When it is necessary to take the weight of the gears on the gear teeth, let them rest on soft wood. After the pinions and gears have been removed, protect them against dirt by covering with a tarpaulin, using the same precautions for the open gear case.



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## Tip Clearance

Q.—What clearance would you leave between the ends of the blades and the cylinder wall?

A.—In a communication in the June, 1928, issue of this magazine, the question of tip clearance was very fully covered for Parsons' turbines.

The radial clearance for impulse-turbine blading has no effect upon the operation of the turbine thermodynamically. In large pressure compound turbines the clearance may vary from 0.18 to 0.25 inch. The main factor influencing the tip clearance in an impulse turbine is to allow sufficient space to prevent the blades striking the casing in case the rotor shaft should whip or get out of true when running at full speed.

## Westinghouse Air Compressor

Q.—Give a brief description of a Westinghouse air compressor.

A.—The compressor consists primarily of an air cylinder, in which the air drawn from the atmosphere is compressed, a steam cylinder, located above the air cylinder, the two being connected by a suitable centerpiece with the steam and air pistons mounted on a common piston rod, and a valve motion controlling steam admission and exhaust. The compressor is double-acting, steam being admitted alternately on either side of the steam piston which, being directly connected with the air piston, causes both pistons to move up and down. On the upward stroke of the air piston the air above it is compressed and discharged into the main reservoir, while the space below is filled with air drawn from the atmosphere. On the downward stroke this operation is reversed.

## Use of the Nozzles in Turbine Operation

Q.—When operating either at low or at high speed, what attention and precautions must be taken in the use of the nozzles in a turbine?

A.—Only the minimum number necessary to deliver the required speed should be used, and those in use should be opened wide. It is more economical to operate with few nozzles and high chest pressure than it is with many nozzles and lower chest pressure. Slight adjustments in speed should be taken care of by using the throttle. The nozzles not in use must be tightly closed, as nozzle valves which are cracked only leak steam and reduce efficiency. In order that uniform blade stresses will be assured, use nozzles adjacent to each other, as a continual use of nozzles widely separated will result in the loosening and, in extreme cases, may cause the dislodging of the blades.

## Turbine Lubrication

Q.—Explain how a turbine engine is oiled, describing the sump pump and its duties, the different pressures and temperatures.

A.—Not knowing what type of turbine engine you have in mind or its size, the lubrication of a turbo-generator set will be described.

The bottom of the gear casing forms a reservoir or sump for the oil. A gear-type oil pump, driven by the governor shaft, runs submerged in the oil and pumps it up through the hollow bracket and pipe to a cooler and to the oil-strainer case, which is mounted on top of the gear case. Here the oil flows by gravity through the strainer and is conducted to the gears and bearings, any excess overflowing into the reservoir. Oil reaches the governor parts directly from the hollow bracket. From the lubricated parts, the oil is carried back to the reservoir through drain pipes. Oil is cooled by a cooler separate from the set.

## Condenser Fittings

Q.—What are the principal condenser fittings?

A.—The principal fittings provided in a condenser are: Drain cocks for both salt and fresh water sides; air cocks to allow any accumulation of air to escape; a boiling out connection; a connection which can be used for putting the shell under test pressure and through which the boiling out solution can be admitted; a connection for pumping out the salt water sides; a water column on condensers fitted with independent condensate pumps; thermometers for overload discharge and condensate temperatures, and a vacuum gage.

## Precautions to Be Observed in Operating Air Compressors

Q.—What are some of the safety precautions to be taken in the operation of air compressors?

A.—Many air-compressor explosions have been caused by dust or moisture in the air used, therefore every effort must be made to have only clean dry air.

Most air-compressor explosions are due to the presence of oil vapor in the air used. Use only the minimum amount of oil necessary for proper lubrication.

Never use kerosene in an air cylinder, as the vapor from the kerosene residue will form a highly-explosive mixture with the air and an explosion may result.

Air-compressors in exposed positions should be thoroughly drained in freezing weather, when not in use.

To avoid accidents that may happen after using the compressor for any purpose, the entire system must be blown out and drained and the pressure gages left open before disconnecting any part of the system for overhaul.

To prevent damage due to overheating, compressors must not be run at excessive speeds and proper cooling-water circulation must be maintained.

## Efficiency of Oil Engines

Q.—Explain the meaning of efficiency, as applied to oil engines?

A.—There is thermal efficiency of the cycle, thermal efficiency of the engine, and mechanical efficiency of the engine. In every pound of fuel oil there is a definite amount of heat which is liberated when the oil is burned in the engine, and a certain fraction of this heat can be converted into mechanical work. For each heat cycle there is a definite amount of heat that represents the maximum possible fraction that can thus be converted by any mechanism used to execute that cycle, and the ratio of this possible maximum to the total amount contained in the fuel is the thermal efficiency of the cycle. The actual engine converts a certain amount of heat into mechanical work. This is always something less than the possible maximum of the cycle employed. The ratio of the amount of heat in each pound of fuel converted into mechanical work to the total amount of heat contained in each pound is the thermal efficiency of the engine. A part of the power developed in the engine cylinder is absorbed in overcoming friction, accelerating the moving parts and running the attached auxiliaries, so that only a part of the power developed is available at the crank shaft for doing work outside of the engine. The ratio of the power thus available to the total power developed in the cylinder is the mechanical efficiency of the engine. The power developed in the cylinders is measured by the indicator.

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# Questions and Answers Relating to Ship Design and Construction

By J. L. Bates, Naval Architect, and W. B. Newton, Marine Engineer

*This department is maintained for the purpose of answering all questions relating to ships and their machinery. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.*

## Draft of River Boat

Q.—We have a steel-hull boat to build and would like to know if we are right on our draft of this boat. The hull is constructed with a scow bow and scow stern, with the sides straight. The hull is 75 feet long, 17 feet 6 inches beam, 4 feet deep. The estimated weights are as follows:

| | |
|---|---|
| Steel | 60,000 pounds |
| Cabin | 24,000 pounds |
| Paddle wheel | 10,050 pounds |
| Engine | 15,500 pounds |
| Auxiliary equipment | 2,000 pounds |
| Gear box | 3,500 pounds |
| Line shaft and bearings | 1,900 pounds |
| Tanks fuel oil | 8,700 pounds |
| Electric equipment | 1,500 pounds |

The center of the engine is 20 feet from the bow; the gear box is 4 feet from the stern; the paddle wheel is 9 feet from the stern; the fuel-oil tanks are in the hull. How much water will this boat draw? or the draft of the vessel.

A.—It is thought that the only satisfactory way to obtain the result desired is to

(a) prepare displacement and longitudinal center of buoyancy curves
(b) read the draft even keel and the location of center of buoyancy therefrom
(c) estimate the longitudinal position of the center of gravity
(d) calculate a value for the moment to alter trim one inch
(e) calculate the trimming moment and ascertain the trim and maximum draft

The above process has been followed. The steps in detail are shown below:

*Calculation for displacement and longitudinal center of buoyancy data.*—Consider the hull to be made up of a central portion of constant cross section and 45 feet in length and of forward and after appendages 18 and 12 feet in length respectively. For simplicity ignore the effect of shell plating, immersed portions of rudders, stern-wheel floats, etc.

| | | Volume in cubic feet | Lever about after end of hull | Longitudinal moments |
|---|---|---|---|---|
| *6 inches draft* | | | | |
| Forward appendage | $17.5 \times .5 \times 3.9 =$ | $34.15 \times$ | $59.6 =$ | 2036 |
| Mid portion | $17.5 \times .5 \times 45 =$ | $393.75 \times$ | $34.5 =$ | 13600 |
| After appendage | $17.5 \times .5 \times 3.4 =$ | $29.78 \times$ | $10.0 =$ | 298 |
| Total in cubic feet | | $457.68 \times$ | $34.8 =$ | 15934 |
| Total displacement in fresh water | | | | 28500 pounds |
| *12 inches draft* | | | | |
| Forward appendage | $34.15 + 17.5 \times .5 \times 6.7 =$ | $92.75 \times$ | $61.0 =$ | 5660 |
| Mid portion | $2 \times 393.75 =$ | $787.50 \times$ | $34.5 =$ | 27200 |
| After appendage | $29.78 + 17.5 \times .5 \times 5.0 =$ | $73.48 \times$ | $9.3 =$ | 684 |
| Total in cubic feet | | $953.73 \times$ | $35.1 =$ | 33544 |
| Total displacement in fresh water | | | | 59400 pounds |
| *18 inches draft* | | | | |
| Forward appendage | $92.75 + 17.5 \times .5 \times 8.4 =$ | $166.25 \times$ | $62.2 =$ | 10340 |
| Mid portion | $3 \times 393.75 =$ | $1181.25 \times$ | $34.5 =$ | 40800 |
| After appendage | $73.48 + 17.5 \times .5 \times 6.3 =$ | $128.58 \times$ | $8.7 =$ | 1120 |
| Total in cubic feet | | $1476.08 \times$ | $35.4 =$ | 52260 |
| Total displacement in fresh water | | | | 92000 pounds |
| *24 inches draft* | | | | |
| Forward appendage | $166.25 + 17.5 \times .5 \times 9.7 =$ | $251.05 \times$ | $62.8 =$ | 15750 |
| Mid portion | $4 \times 393.75 =$ | $1575.00 \times$ | $34.5 =$ | 54400 |
| After appendage | $128.58 + 17.5 \times .5 \times 7.1 =$ | $190.78 \times$ | $8.0 =$ | 1525 |
| Total in cubic feet | | $2016.83 \times$ | $35.6 =$ | 71675 |
| Total displacement in fresh water | | | | 125500 pounds |

In deriving the above data it has been assumed that the curved portions of the end contours are arcs of circles. These are shown in Fig. 2. The displacement and center of buoyancy data are plotted in Fig. 3.

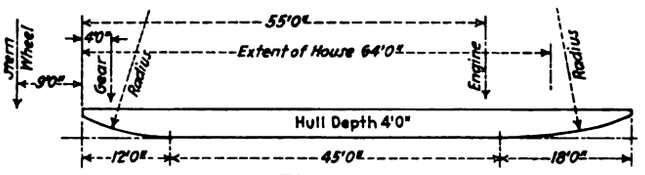


Fig. 1

*Estimate of longitudinal position of center of gravity of ship.*—The weights quoted in the question have been accepted as well as the locations, when given. The details of the estimate follow:

| Item | Weight pounds | Lever about after end of hull | Longitudinal moment |
|---|---|---|---|
| Steel | 60,000 | 36.5 | 2,190,000 |
| Cabin | 24,000 | 33.0 | 792,000 |
| Paddle wheel | 10,050 | −9.0 | −90,450 |
| Engine | 15,500 | 55.0 | 852,500 |
| Auxiliary equipment | 2,000 | 50.0 | 100,000 |
| Gear box | 3,500 | 4.0 | 14,000 |
| Line shaft and bearing | 1,900 | 27.0 | 51,300 |
| Tanks fuel oil | 8,700 | 56.0 | 487,200 |
| Electric equipment | 1,500 | 50.0 | 75,000 |
| Total | 127,150 | 35.2 | 4,471,550 |

No item of margin appears as such in the above weight statement. It is usually desirable to make some provision for possible overweight in estimates such as the above. Accordingly sufficient margin is assumed to be added to bring the weight up to 132,000 pounds. The center of gravity is unchanged.

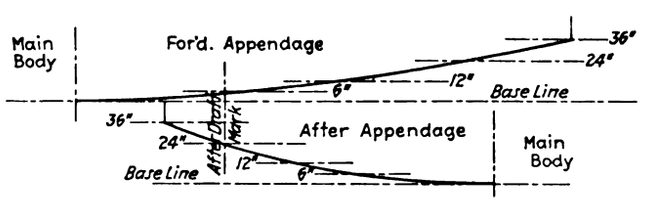


Fig. 2

The mean draft, without trim, corresponding to 132,000 pounds displacement is 25 inches. The center of buoyancy is 35.6 feet forward of the after end of hull,

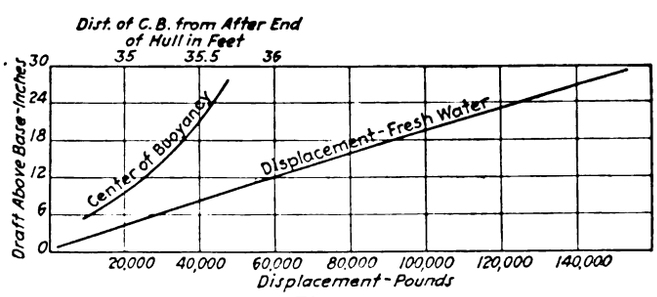


Fig. 3



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while the center of gravity is 35.2 feet forward of the same point of reference. This will result in a slight trim by the stern, the trimming lever being 0.4 foot.

The trim in inches is equal to the trimming moment divided by the moment to alter trim one inch.

The trimming moment = 132,000 × 0.4 = 52,800 foot pounds.

$$\text{The approximate moment to alter trim one inch} = \frac{D \times BM}{L \times 12}$$

where, D = displacement in pounds
BM = longitudinal metacentric radius in feet
L = length in feet between draft marks

Assume draft marks are to be placed at the ends of the 24-inch waterline.

$$D = 132{,}000 \qquad L = 69.4$$

$$BM = \frac{17.5 \times 69.4^3}{12 \times \frac{132{,}000}{62.3}} = 230$$

$$\text{Approximate moment to alter trim} = \frac{132{,}000 \times 230}{69.4 \times 12} = 36{,}400$$

foot pounds.

$$\text{Then trim by stern} = \frac{52{,}800}{36{,}400} = 1\tfrac{1}{2} \text{ inches.}$$

Draft to base line at after draft mark (2.2 feet forward of after end of hull) = 25 + ¾ = 25¾ inches.

It should be noted that the above draft is at the point specified, viz: 2.2 feet forward of after end of hull. If the rudder blades and lowest points of wheel buckets are brought down to or below the base line, the drafts at these points will be more than 25¾ inches.

# Communications

## Powdered Coal as Fuel on River Boats

New Orleans, La.

To the Editor:

I desire to answer several of the criticisms made by Warren C. Graham, published in the August issue of your journal, on my article appearing in the June issue. First, I wish to say that my article was along general technical lines, for the purpose of bringing forward engineering discussion, and not individuals. Mr. Graham questions the source of my information and its reliability. In view of the fact that the writer was connected with the Mississippi Warrior Service as inspector of floating equipment and master mechanic for six years, and while employed in this capacity had an opportunity to study the performance and operating costs of the equipment in question, there can be no doubt as to the source of my information and its reliability, unless one desires to question the records of the Mississippi Warrior Service. Further, the writer has no "axe to grind" in the matter of fuel adoption, and therefore is not in the same position as Mr. Graham who is endeavoring to gain his livelihood by selling and installing powered-coal equipment.

Mr. Graham states that oil is not used on the *Illinois*, except as required for the purpose of starting the fires. If this were the case, it is an admission on his part that great difficulty has been experienced in this matter, or how would he otherwise explain the fact that repeated alterations have been made to the oil-burning system, while the center of gravity is 35.2 feet forward of the on a scale sufficient to operate the boat under normal conditions. Further, the records show fuel-oil consumption for this vessel in alarming proportions, if its use is confined to the starting of coal fires.

It is also stated that the *Illinois* is the first vessel to have successfully burned powdered coal. If Mr. Graham measures the success by the amount of fuel consumed, then it must be agreed that it is successful, for the coal consumed as a powdered-coal burner exceeds that used for the full-power operation of the vessel when hand-firing was employed.

If Mr. Graham has anything to bring out to further engineering knowledge, the writer will welcome an opportunity to discuss the matter fully.

F. C. Moyer.

## The Steward's Department

Newport News, Va.

To the Editor:

Viewed from any standpoint, the United States Lines, whose fleet consists of the *Leviathan, George Washington, America, Republic, President Harding* and *President Roosevelt,* has perhaps the most unbalanced fleet ever operated in the highly competitive North Atlantic passenger, mail and cargo service. The units of this fleet vary from 13,869 to 59,956 gross tons, the lengths vary from 535 to 950 feet, the speeds vary from less than 14 to more than 24 knots and the horsepowers of the main propelling plants vary from 7500 indicated to 90,000 or 100,000 maximum shaft horsepower. While some vessels have steam reciprocating main engines and Scotch boilers, others have geared turbines and watertube boilers and one vessel has direct-drive turbines and express type watertube boilers. Some vessels burn coal as fuel and others oil, some vessels have few passenger accommodations for the size of the vessel while others have maximum passenger accommodations. Some cater to cabin, tourist and third-class passengers while one caters to first or *de luxe* class passengers as well as second, tourist and third classes. Two of the vessels have been built in American shipyards, two in British and two in German shipyards. Some were built comparatively recently and others more than two decades ago. Certain of the vessels have been constructed on the Isherwood system and others on the transverse system of hull construction.

Out of the operation of this heterogeneous fleet of vessels, however, a vast amount of invaluable technical and practical knowledge pertaining to ships and their operation has been obtained, analyzed and is available for use when the effort is made to design, build and place in service in this most important trade route, a formidable commercial fleet of large passenger and mail vessels of surpassing speed, worthy and representative of American enterprise. Some of this knowledge has been disseminated through the technical press at various times. Mr. L. Schumacher, commissary controller of the United States Lines, in his timely and excellent article in your last issue on "Efficiency and Economy in the Steward Departments on Passenger Vessels," draws on his experience with certain vessels of that fleet as well as calling attention to the galley and pantry layouts of vessels in general.

The discerning passenger aboard ship is concerned with, among other factors, *safety, comfort, service* and *speed.* Of these, the article of Mr. Schumacher's dis-

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cusses service as it relates to food. *Too much emphasis cannot be made upon the necessity for considering fully in the early stages of design the galley, pantry, passenger dining room and crew mess room layouts and their location together with stores facilities and their accessibility to the galleys and pantries as well as their convenience for loading supplies, all to the end that maximum service to passengers will be obtained with minimum effort and waste.* The importance of proper food and its service to crew must equally be borne in mind to ensure holding capable and contented crews on board the vessel.

It can hardly be said that naval architects in general, or those having close association with the design, construction, redesign, reconditioning and operation of transatlantic passenger vessels in particular, fail to appreciate the importance of obtaining expert advice in the matter of galley and pantry layouts. In fact, to my knowledge, it has been the practice to work hand in hand with commissary superintendents, port stewards, chief stewards and chefs to obtain the best layout for these spaces that conditions will allow, it being always remembered that, after all, ship design is largely a matter of compromise. The naval architect is always seeking a well balanced design, even though the ideal in one phase may be sacrificed in the interests of the whole design.

One of the difficulties in the past, in so dealing with the steward staff, has been (except in few instances) their inability to understand plans and to visualize beforehand the layout proposed. Another difficulty is that some very capable chefs are as tempermental as prima donnas, whereas there is nothing tempermental in the design and construction of ships or their galley or pantry layouts. I recall an instance eight years ago when the *George Washington* was reconditioned and restored to the transatlantic passenger service, after having been a troop transport. The galleys and pantries were arranged and equipped to meet the exacting requirements of the then commissary superintendent and the vessel's chef, both of whom had great experience in their respective positions. Before the vessel was placed in service the commissary superintendent and the vessel's chef were replaced. The result of this change was that some $25,000 was expended to alter the galley and pantry arrangements to meet the requirements which the successors (also very capable men) considered necessary to ensure good service. Then again, shortly after the *Leviathan* was placed in service some personnel changes were made in the steward's department and these in turn were followed by rather extensive alterations in the galley. Also, during the reconditioning of the *Republic* the galley and pantry arrangements were modified completely to suit the operators who held views that were different from those held by the steward's staff charged with supervising the reconditioning. The point here is that almost every chef and steward has a different opinion as to what is best. Mr. Schumacher should be commended for endeavoring to reduce these various and often decidedly conflicting views to a scientific basis outlining the fundamentals of the problem.

The arrangement of galley, pantry and dining room, indicated in Fig. 1 of the article, is common to sixteen 535-foot vessels, two of which are in the North Atlantic service, a service for which they were not intended and are not suited. Mr. Schumacher's solution, indicated in Fig. 2, of the difficiencies of the original layout is worthy of study but it is extremely doubtful if the United States Lines or any of the present owners of the balance of these vessels will undertake to effect the change proposed despite the fine picture of the economics of the situation which Mr. Schumacher has given us.

Mr. Schumacher in his present article has made a splendid start, but it is only a beginning and it is to be hoped that it will be the forerunner of several more articles in which the problem of stores, both dry and refrigerated, will also be discussed. Could not Mr. B. D. Pender, head of the passenger ship equipment section of the Merchant Fleet Corporation, Mr. Hart, port steward at New York of the Merchant Fleet Corporation, Chief Steward Linn of the *Leviathan*, Chief Steward Clarkin of the *George Washington*, and Mr. J. D. Williams of the Newport News Shipbuilding & Dry Dock Company, all of whom, like Mr. Schumacher, have had unusual opportunities to solve phases of this important service problem, be persuaded to contribute their views on the efficiency and economy in the steward's department of passenger vessels?

Carl E. Petersen.

# New Books

The Design of Merchant Ships and Cost Estimating. By Alexander Kari, M.Sc. Size, 6½ by 10¼ inches. Pages, 299, London, Eng., 1927: Crosby Lockwood and Son.

To the technical man interested in the design and construction of merchant vessels and their costs, the recently published book "The Design of Merchant Ships and Cost Estimating," by Alexander Kari, will appeal. The subject of costs in relation to the component parts of the ship, its machinery, its outfit and equipment and finally the ship as a unit of ocean commerce is perhaps equally important with that of design. Almost all of the principal ocean trades are today keenly competitive and in order to evolve for a particular service the most satisfactory and economical ship, all things considered, a thorough knowledge of shipbuilding costs is one of the essentials. The writer has previously stated that "perhaps to a greater extent than any other factor, the first cost of a vessel will influence the financial results; an excessive cost will preclude the vessel being an economic success, almost regardless of how efficient or desirable the vessel may be from the technical and traffic viewpoints." For this reason the writer has willingly acceded to the editor's request to present a brief general review of Mr. Kari's book. It is the first book of its kind in that it deals with costs in a technical and practical way, and, so far as is known, it is the only book on estimating the cost of shipwork since the appearance of "Estimating the Cost of Work," by William B. Ferguson.

In order to design the most satisfactory and economical vessel for a particular trade under the conditions likely to exist for the life of the vessel, the naval architect needs, today more especially than in the past, to be more than a ship designer and a shipbuilder; he should have an intimate knowledge of building and operating costs, he should be a shipping trade analyst and an economist—in short, he should, and progressive shipowners will demand that he, determine the principal features of design from the traffic and conditions peculiar to the trade in which the vessel is to engage. The business of predetermining or estimating the cost of shipwork, whether new or repair, is distinctly a pro-

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fession, requiring in an individual so engaged a particular kind of mind backed by extensive practical and technical experience together with an accummulation of pertinent data and the knowledge of how to use such data intelligently and soundly.

Mr. Kari's work is divided into three parts. The first takes up the design of merchant ships; the second, weight and cost estimating and preliminary calculations, while the third is devoted to powering of ships. The nine chapters which form part one are entitled: I—The Choice of a Type of Hull, II—Determination of a Ship's Dimensions, III—Freeboard Calculations, IV—The Preliminary General Arrangement for a Cargo or a Passenger Ship, V—The Preliminary General Arrangement for an Oil-Carrying Ship, VI—General Arrangements for Insulated Ships, VII—General Arrangements of Special Service Units, VIII—Miscellaneous Regulations and IX—The Spacing of Watertight Bulkheads in Passenger Ships. The four chapters which form part two are entitled: X—Weight and Cost Estimates, XI—Wood and Outfit, XII—Size and Weight Approximations for Propelling Machinery of the Steam Reciprocating Type, and XIII—Preliminary Calculations. Part three has but one chapter, XIV—Resistance and Propellers.

In some respects the volume is invaluable, as many useful tables are given, but in other respects it is somewhat disappointing. It endeavors, as its title implies, to cover a large field. Particular prominence is given to certain special types of vessels, such as dredgers, ice-breakers, etc., with which the author undoubtedly has had wide experience. This is done to the exclusion of other types of vessels of a more general character. The presentation of the subject in Chapters I, II, IV, VI and IX is poor. Those chapters relating to the general arrangement of vessels are decidedly elementary and should be revised in any subsequent edition. The sketches of minor joiner fittings could well have been omitted from such a work. Forty-one pages have been devoted to the powering of ships, while, on the other hand, the treatment of some subjects is unusually casual.

Such an important phase of passenger ship design as the spacing of watertight bulkheads is glossed over in seven pages, half of which are used for tables.

The book has been the subject of considerable controversy in the foreign technical press and does contain features about which wide differences of opinion exist and the experience of the reader must be blended with the text and data given in the book, if the best results are to be obtained from its use. Considering the title and the table of contents, one would naturally expect that all subjects were covered with reasonable adequacy, but this unfortunately is not so. Nevertheless the book will make a valuable reference, although falling short of consideration as a standard work, on any ship designer's and estimator's bookshelf.

Carl E. Petersen, Naval Architect.

## Foreign Books Received

La Statica Della Nave. By Angelo Scribanti. Size 8¼ by 5½ inches. Pages, 296. Illustrations, 27. Milan, 1928: Ulrico Hoepli. Price, 30 lire, paper covers.

Die Kompressorlose Dieselmaschine. By Ludwig Hausfelder. Size, 10 by 7 inches. Pages, 375. Illustrations, 256. Berlin, 1928: M. Krayn. Price, 20 marks, paper covers.

Dieselmaschinen. By Professor Dr. Ing. J. Magg. Size, 11½ by 8½ inches. Pages, 278. Illustrations, 355. Berlin, 1928: Vdi-Verlag. Price, 26 marks, cloth binding.

# Personal

**Captain Wat Tyler Cluverius** has been appointed commandant of the **Norfolk Navy Yard,** succeeding **Rear Admiral William C. Cole.** Captain Cluverius began his new duties July 2.

**Thomas G. Munro,** in charge of the San Francisco maintenance and repair division of the **United States Shipping Board,** has been transferred to Los Angeles as Pacific coast director.

**Kenneth D. Dawson,** president of the **States Steamship Company,** Portland, Ore., has been appointed a director of the **Associated Oil Company of California.**

**Robert James Noble, Jr.,** has recently resigned as first vice-president and general manager of the **Ocean Dominion Steamship Corporation,** New York. **Harmon Lewis,** formerly vice-president of the corporation, has been appointed president and general manager.

**Captain Raymond A. Johnson** of the steamship **Walter A. Luckenbach** resigned his command recently to become port superintendent at Seattle, Wash., for the **Luckenbach Steamship Company, Inc.** He was succeeded by **Captain L. S. Jellison.**

**Captain Elmer E. Crowley,** former president of the **Merchant Fleet Corporation,** has resigned from the **William F. Kenny** organization, New York, with which he has been connected for the past two years as an advisory expert on shipping. He has opened an office at 1 Broadway, New York city, where he will continue his activities in the shipping industry.

**Henry Williams,** vice-president of the **Baltimore & Carolina Steamship Company,** Baltimore, Md., has been appointed president of the company, succeeding the late **Mason L. Weems Williams. George Weems Williams** was appointed vice-president, and **Theodore Weems Forbes, L. E. Mason** and **J. E. Jones,** were appointed directors.

**T. A. McQuiling,** consulting engineer of the **New York Marine Engineering Company,** New York, has been appointed by the **Tampa Inter-Ocean Steamship Corporation** to survey, prepare specifications, and supervise repairs on the vessels which that concern is operating for the **United States Shipping Board.**

# Obituary

**Michael F. Adams,** general superintendent of the Baltimore plant of the **Bethlehem Shipbuilding Corporation, Ltd.,** Baltimore, Md., died recently.

**Mason L. Weems Williams,** president and general manager of the **Baltimore & Carolina Steamship Company,** (the **Weems Line**) Baltimore, Md., died recently at his home in Baltimore.

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# Ship Construction and Repair News

Proposed work—Bids asked—Bids received—Contracts awarded—Current activities

## New England Steamship Co. Receives Bids on Small Steamer Construction

TENDERS for the construction of one passenger and automobile ferryboat were received by the New England Steamship Company on September 26. This new vessel will be similar to the *New Bedford* which was recently completed by the Bethlehem Shipbuilding Company, Quincy, Mass., with the exception that an extra deck with staterooms will be added and all rooms will be supplied with hot and cold running water. The new boat will have the following particulars:

| | |
|---|---|
| Length overall | 250 feet |
| Length between perpendiculars | 240 feet |
| Beam, molded | 45 feet |
| Beam, over guards | 60 feet |
| Depth, molded | 16 feet |
| Draft | 10 feet |

She will have twin screws, driven by two 4-cylinder triple-expansion engines of 2000 horsepower each. Steam will be supplied by two Babcock & Wilcox boilers. The vessel will have a speed of 14 knots.

In addition to the bids based on steam propulsion, alternate proposals of Diesel-electric power were considered.

When completed, the new boat will operate on the New Bedford, Marthas Vineyard & Nantucket Steamboat Line, New Bedford, Mass., a subsidiary of the New England Steamship Company.

## Dollar Line Plans Two Trans-Pacific Electric Liners

THE Dollar Steamship Line, San Francisco, Cal., will build two turbo-electric liners patterned after the 22,000 ton Panama-Pacific liner *California,* for the trans-Pacific service, as announced on September 18 by Captain Robert Dollar, president of the company. The vessels will cost $7,000,000 each and it is anticipated that the new liners will be followed later by an entire fleet of electrically driven ships for the Far Eastern service.

It is reported that the new Dollar liners will have a speed of around 20 knots and will be somewhat longer than the ships employed in the transpacific trade.

## Two Fast Vessels Planned for the Matson Line

PLANS are under way at the Union Plant of the Bethlehem Shipbuilding Corporation, Ltd., San Francisco, California for the construction of two fast passenger and freight liners for the Matson Navigation Company, San Francisco, California. While full details are not as yet available it is understood that the new vessels will be 625 feet long and will have a speed of 21½ knots.

## Contract for Inter-Island Steamer Awarded Bethlehem Shipbuilding Corp.

A CONTRACT for a sister ship to the steamship *Waialeale* for the Inter-Island Steam Navigation Company, Ltd., Honolulu, T. H., has beeen awarded to the Union plant of the Bethlehem Shipbuilding Corporation, Ltd., San Francisco, Cal. The *Waialeale* is 310 feet 10 inches overall with a beam of 48 feet, a draft of 17 feet 4½ inches and a deadweight of 1800 tons. She is a twin-screw vessel and is driven by geared turbines. The new ship, like the *Waialeale,* will cost approximately $1,500,000. She will be a 4-decked vessel with a cruiser stern and will be equipped for the handling of passengers and cargo.

## Bids Asked for Construction of One Survey Steamer

BIDS for the construction of one survey tender will be received by the United States Coast and Geodetic Survey, Washington, D. C., on October 19. Specifications call for a Diesel-propelled craft of 77 feet 6 inches length overall, 16 feet 6 inches beam, 10 feet 3 inches depth, 6 feet draft with a displacement of 90 tons.

Propelling machinery will consist of a full Diesel engine developing 110 horsepower at 350 revolutions per minute. This engine will be direct reversing and direct connected to the propeller shaft.

The appropriation available for constructing and equipping this tender amounts to $58,000.

## Construction of New Vessel Proposed by Inter-Island Co.

INFORMATION has been received that plans are under way for the construction of one new passenger and cargo vessel for the Inter-Island Steam Navigation Company. Ltd., Honolulu, T. H. It is expected that this vessel will be a sister ship to the steamship *Hawaii.* The *Hawaii* is 190 feet long with a beam of 36 feet, a depth of 16 feet and a deadweight of 850 tons. One 1000-horsepower triple expansion engine is employed for propulsion.

## Pusey & Jones Corp. Plans Two Small Vessels

INFORMATION has been received that plans are being prepared at the plant of The Pusey & Jones Corporation, Wilmington, Delaware, for two small vessels. Details are not available at the present time.

## Contract for Converting Two Shipping Board Vessels Awarded Maryland Drydock Company

THE Maryland Drydock Company, Baltimore, Md., was recently awarded a contract for the installation of Diesel engines in two of the eight United States Shipping Board vessels selected for conversion to motorships, at a cost of $1,064,368. Bids for the work were received at the offices of Captain R. D. Gatewood, manager of the maintenance and repair division of the board, 45 Broadway, New York city, on August 21. The tenders for the conversion of the other six vessels are being held subject to further consideration.

The steamships *Galveston* and *Oldham* are the vessels assigned to the Maryland Drydock Company. McIntosh & Seymour Diesel engines will be installed.

## Ward Line Plans Construction of Two New Passenger Vessels

PLANS and specifications for the construction of two new fast passenger liners for the New York & Cuba Mail Steamship Company (Ward Line), Wall street, New York city, have been prepared by Theodore E. Ferris, naval architect, 30 Church street, New York city, and will shortly be issued to prospective bidders. The vessels will have a length overall of 508 feet; beam 59.8 feet; draft 26 feet; displacement 15,750 tons; gross tonnage 11,300, and net tonnage 5700. They will be twin-screw vessels and will be driven at a speed in excess of 18 knots by single reduction geared turbines. Accommodations will be provided for 378 first-class and 90 second-class passengers. A crew of about 200 will be carried.

It is estimated that the building of these two liners will require about two years' time.

## Contracts for Ninety-Two Steel Barges Awarded

THE Mississippi River Commission First and Second Districts, Memphis, Tenn., has awarded contracts amounting to approximately $1,000,000 for the construction of 92 steel barges. The Riter-Conley Company, Pittsburgh, Pa., will construct 31 of the barges at a price of $10,263 each; the Dravo Contracting Company, Pittsburgh, Pa., 31 barges at $10,200 each, and the American Bridge Company, Ambridge, Pa., 30 barges at $10,400 each. Bids for the work were received by the Mississippi River Commission on August 17.

The barges are to have the following dimensions: Length 120 feet; beam 30 feet; depth, molded, 7 feet; length of end rakes 15 feet; camber of beams, 4 inches.



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They are to be constructed of steel throughout, have flat bottoms, rounded bilges, straight sides, circular end racks, and a one-foot straight sheer at each end.

## Bethlehem Yard Awarded Contract for Erie Carfloat

A CONTRACT for the construction of one carfloat, for the Erie Railroad, 50 Church street, New York city, was recently awarded to the Bethlehem Shipbuilding Corporation, Ltd., New York city. Bids for the work were opened privately on August 22. The price involved was not given out.

Tenders for the construction of five lighters and one steam hoist were received August 1. It is expected that new tenders will shortly be called. Although details are not yet available, it is believed the vessels will be of steel instead of wood construction.

## Bids for New York State Ferryboats' Machinery Due October 10

THE date for the receipt of bids for furnishing machinery for installation in the two 115-foot Diesel-electric ferryboats for the Manhattan State Hospital, Wards Island, N. Y., was postponed from September 12 to October 10. Tenders for the construction of the ferryboats were received on August 29, but these were rejected. The rejection of the tenders was based upon the fact that the lowest bid was informal because it was not accompanied by a deposit, and that other low bids were informal because they were accompanied by bidders' bonds instead of the five percent deposit required by law.

## S.S. Calmar Repair Contract Awarded

A CONTRACT for repairs to the Calmar Line steamship *Calmar*, which was recently in collision with the British steamship *Canadian Rover* in a fog off Point Arenas, San Francisco, was awarded to the Hunter's Point Works of the Bethlehem Shipbuilding Corporation, Ltd., San Francisco, Cal. The work will require from two to three weeks during which time all the machinery in the engine room will have to be taken from the ship, repaired and set up again. The price involved was not made public.

The *Canadian Rover* sailed from San Francisco and permanent repairs to the freighter will be made when the vessel reaches Vancouver.

## Steel Dredge Hull Contract Awarded

T. F. FARRELL, commissioner of Canals and Waterways, Department of Public Works, Albany, N. Y., has awarded a contract for the construction of one steel hull for the dredge *St. Johnsville* to the New York Engineering Company, 75 West street, New York city, at a price of $31,800. Bids for the work were received on August 30. The dredge is to be used at Syracuse, N. Y.

## Issue of Export Line Plans Pending Shipping Board Loan Agreement

ALTHOUGH the United States Shipping Board has acted favorably on the Export Steamship Corporation's application for a loan from the board's construction loan fund, the stipulations are such that it was deemed advisable by the Export Steamship Corporation to withhold issuing plans and specifications for the construction of four new passenger and freight vessels until some definite agreement with the board is reached.

The new vessels are to have a length between perpendiculars, 450 feet; a molded beam, 59 feet, and a molded depth, 46 feet 6 inches. They will have a deadweight tonnage of 9500 on a draft of 27 feet 10½ inches. The plans and specifications for the vessels were prepared by George G. Sharp, and James Donald, naval architects, 30 Church street, New York city.

## General S.S. Co. Awards Contract For Three Motorships

THE General Steamship Corporation, 240 Battery street, San Francisco, Cal., recently let contracts for the construction of three motorships to be entered in the service of the Westfal-Larsen Line between the Pacific Coast and the East Coast of South America. The vessels are to be built in England. They are to have a speed of 14 knots and a deadweight capacity of 9000 tons. Each ship will be equipped with space for 60,000 cubic feet of refrigerated cargo.

The new vessels, which will replace the steamers *Evanger, Hardanger* and *Leikanger* now operating in the company's service, will be ready to go into operation for the August, October and November sailings from the Pacific Coast in 1929.

## Contract for Barge Pittsburgh Repairs Awarded

THE Gibbs Gas Engine Company of Florida, Jacksonville, Fla., was recently awarded a contract covering repairs to the barge *Pittsburgh*. The barge, which was recently in collision, sustained a large hole in her hull. She was towed to Jacksonville by the tug *A. B. Potter* of the Jacksonville Forwarding Company of West Palm Beach.

## Contract Awarded for Constructing Three Fuel Barges

THE Union Barge Line Corporation, Wabash building, Pittsburgh, Pa., has placed a contract for the construction of three fuel barges with the Midland Barge Company, Midland, Pa. The price involved was not made public.

## Contract Awarded for Steel Barge Construction

A CONTRACT for the construction of a steel barge was recently awarded to the Jones & Laughlin Steel Corporation, Pittsburgh, Pa., by the American Tar Products Company. Union Trust building, Pittsburgh, Pa. The price involved was not made public.

## McColl Co. Contemplates New Tanker Construction

THE McColl Company, Ltd., Toronto, whose tank steamer the *R. M. McColl* was recently destroyed by fire, contemplates building a new vessel to replace her.

## U. S. Engineers Award Contract for Construction of One Barge

THE United States Engineer Office, Chicago, Ill., recently awarded a contract for the construction of one steel barge to the Charles Hegewald Company, New Albany, Ind., at a price of $7790. Bids for the work were received on August 16.

The vessel is to have a length of 80 feet; beam of 22 feet; depth of 4 feet 6 inches at gunwale; crown of deck 4 inches, and sheer, fore and aft, 12 inches in 16 feet.

## Automatic Refrigeration Installed On S.S. Leviathan

AUTOMATIC refrigerating equipment is being installed upon the *Leviathan*, flagship of the United States Lines, New York, according to information received from J. J. Pocock, Frigidaire distributor for Philadelphia. The new equipment includes a circulating cold water system on B deck large enough to meet the requirements of 800 first-class passengers, and a combination cooling box for the crew which will keep both meat and fish at their proper temperatures.

## Grace Line Plans Refrigeration Installation on West Coast Steamers

THE Grace Line, Inc. (W. R. Grace & Company), 10 Hanover Square, New York city, is planning the installation of refrigeration space on its West coast steamers. The first installation will be of 2500 cubic feet in the *Cuzco*. Should this meet the needs of the company, the space on the *Cuzco* will be enlarged and similar installations will be made in its other steamers.

## Contract for Power Boat Awarded

THE Lighthouse Inspector, Lighthouse Service, Department of Commerce, Staten Island, N. Y., recently awarded a contract for the construction of one 24-foot power boat to the Hemming Larsen Boat Works, at a price of $1850 f. o. b. Marinette, Wis. Bids for the work were received at Staten Island on August 20.

## Bids for Towboat Construction

SEALED proposals were received by the United States Engineer Office, Chattanooga, Tenn., until September 21, for the construction of one towboat. The vessel will be driven by Diesel-electric machinery. Further details may be obtained by application.

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# Construction and Repair Bids

## Bids Received for Constructing Three Lightships

TENDERS were received on September 6 by the Department of Commerce, Bureau of Lightships, Washington, D. C., for the construction of three lightships and supplying the machinery for these vessels. The lightships will be designated as *Nos. 115, 116* and *117*. They will have a length overall of 133 feet 3 inches; a length on the waterline of 108 feet 9 inches; a beam of 30 feet; a draft of 12 feet 6 inches, and a displacement of 630 tons. The vessels will be equipped with four 120-horsepower Diesel engines. The bids submitted for the hulls were as follows:

| Name | Total Price | No. Time |
|---|---|---|
| Charleston Drydock & Machine Company, Charleston, S. C. | $554,766 | 1—420 days<br>2—540 days<br>3—660 days |
| American Brown Boveri Electric Corporation, Camden, N. J. | 588,000 | 1—240 days<br>2—270 days<br>3—300 days |
| Staten Island Shipbuilding Company, Staten Island, N. Y. | 623,400 | 1—240 days<br>2—270 days<br>3—300 days |
| Sun Shipbuilding & Drydock Company, Chester, Pa. | 649,800 | 1—225 days<br>2—260 days<br>3—280 days |
| Bethlehem Shipbuilding Corporation, Ltd., Bethlehem, Pa. | 661,500 | 3—390 days |
| Bath Iron Works Corporation, Bath, Maine | 687,200 | 3—400 days |
| New London Ship & Engine Company, Groton, Conn. | 688,500 | 1—300 days<br>2—330 days<br>3—360 days |
| Federal Shipbuilding Company, Kearny, N. J. | 738,000 | 1—270 days<br>2—315 days<br>3—360 days |

The tenders for the machinery were as follows:

### Appendix "A"

| Name | Amount | Days |
|---|---|---|
| Winton Engine Company, Cleveland, Ohio— | | |
| Air Injection (General Electric) | $153,360 | 195 |
| Solid Injection (General Electric) | 146,000 | |
| Air Injection (Westinghouse) | 161,560 | |
| Solid Injection (Westinghouse) | 154,200 | |
| Treiber Diesel Engine Corp., Camden, N. J.— | | |
| 4 Cylinder (Westinghouse) | 200,499 | 180 |
| 6 Cylinder (Westinghouse) | 205,299 | to |
| 4 Cylinder (General Electric) | 197,976 | 210 |
| 6 Cylinder (General Electric) | 202,776 | |
| Washington Iron Works, Seattle, Wash.— | | |
| 4 Cylinder (General Electric) | 165,000 | ... |
| 5 Cylinder (General Electric) | 183,000 | 150 |
| 4 Cylinder (Westinghouse) | 173,350 | 240 |
| 5 Cylinder (Westinghouse) | 191,350 | 300 |
| Bethlehem Steel Company, Bethlehem, Pa.— | | |
| 3 Cylinder (Solid Injection) | 196,683 | 220 |
| Hill Diesel Engine Company, Lansing, Mich.— | | |
| Air compressor | 7,560 | ... |
| Air compressor and auxiliary gen. | 12,120 | ... |

### Appendix "B"

| | | |
|---|---|---|
| Winton Engine Company, Cleveland, Ohio— | | |
| General Electric 3 @ | 6,987 | 195 |
| Westinghouse 3 @ | 7,087 | |

### Appendix "D"

| | | |
|---|---|---|
| Lidgerwood Manufacturing Company, Elizabeth, N. J.— | | |
| Boat Hoists | 4,920 | 90 |
| Hyde Windlass Company, Bath, Maine— | | |
| Boat Hoists (Electro Dynamic) | 4,845 | 180 |
| Boat Hoists (General Electric) | 7,335 | |
| Boat Hoists (Westinghouse) | 5,910 | |
| Windlass (Electro Dynamic) | 18,075 | .. |
| Windlass (General Electric) | 18,075 | .. |
| Windlass (Westinghouse) | 19,710 | .. |
| American Engineering Company, Philadelphia, Pa.— | | |
| Windlass | 18,000 | 91 to 98 |
| Boat Hoist | 5,700 | 14 wks. |

### Appendix "E"

| | | |
|---|---|---|
| Worthington Pump & Machinery Corp., New York city— | | |
| Air Compressor (General Electric or Westinghouse) | 2,205 | 70 days |

No contracts have as yet been awarded pending decision by the authorities at Washington.

## New Bids for New York State Ferry Boats Received September 28

THE tenders received by Lewis M. Farrington, secretary of the Department of Mental Hygiene, Albany, N. Y., on August 29 for the construction of two 115-foot Diesel-electric ferry boats for the Manhattan State Hospital, Ward's Island, N. Y., were rejected and new bids were received on September 28. The rejection of the tenders was based upon the fact that the lowest bid was informal because it was not accompanied by a deposit, and that other low bids were informal because they were accompanied by bidders' bonds instead of the five percent deposit required by law.

## Bids for Towboat Engines Opened September 21

TENDERS were received September 21 by the United States Engineer Office, Chattanooga, Tenn., for furnishing the Diesel engines and electrical equipment for installation in a new steel-hull, stern-wheel, Diesel-electric towboat. The general details for the towboat have not as yet been completed. The proposals call for the following equipment:

Two Diesel engines of 150 brake horsepower each, together with selected spare parts, accessories, switchboards, two propelling motors and controls. The engines are to be the product of American manufacture by a firm regularly engaged in the manufacture of Diesel engines. They are to be of the mechanical injection type, vertical, with not less than four or more than six cylinders. The four-cycle, mechanical injection type are to have a piston speed not to exceed 850 feet per minute and a brake mean effective pressure not to exceed 84 pounds per square inch.

The electrical equipment to be furnished is to comply with the requirements of General Specifications for Electrical Appliance on Shipboard No. 100 B, unless otherwise specified. Two open type direct-current generators suitable for direct connection to the Diesel engines are also to be supplied. Further details may be obtained by application.

## Bids Received for Repairs to Carfloat No. 60

THE New York, New Haven & Hartford Railroad, New Haven, Conn., recently received bids covering repairs to car float *No. 60* at which time James Shewan & Son, Inc., was low bidder. The bids received were as follows:

| Name | Item A-1 | Item A-2 | Days |
|---|---|---|---|
| James Shewan & Sons, Inc. | $ 9,374 | $10,121 | 12 |
| Theodore A. Crane's Sons Company | 9,509 | 9,928 | 16 |
| Tietjen & Lang Dry Dock Company | 9,758 | 9,870 | 12 |
| Staten Island Shipbuilding Company | 10,828 | 10,828 | 12 |
| Morse Dry Dock & Repair Company | 12,446 | 12,896 | 18 |
| Todd Dry Dock Engineering and Repair Corporation | 15,331 | 14,581 | 14 |

Contract has not as yet been awarded.

## S.S. Commercial Navigator Repair Bids Opened

TENDERS were recently received at the offices of Frank S. Martin & Son, naval architects, 25 Broadway, New York city, covering grounding damage repairs to the Moore & McCormack steamship *Commercial Navigator*, with the following results:

| Name | Price | Days |
|---|---|---|
| Tietjen & Lang Drydock Company | $47,672 | 20 |
| New York Harbor Drydock Company, Inc. | 48,750 | 24 |
| Morse Drydock & Repair Company | 48,920 | 30 |
| Robins Drydock & Repair Company | 49,165 | 21 |
| Staten Island Shipbuilding Company | 49,240 | 20 |
| W. & A. Fletcher Company | 50,750 | 24 |

Several prices were submitted on a number of miscellaneous items which were not figured in the totals. The contract has not as yet been awarded.

## S. S. West Kedron to be Repaired at Morse Drydock

A CONTRACT for general repairs to the Shipping Board steamship *West Kedron* has been awarded to the Morse Drydock & Repair Company, Brooklyn, N. Y., at a price of $13,022. Bids for the work were recently received at the New York office of the board with the following results:

| Name | Price | Alternate Price |
|---|---|---|
| Morse Drydock & Repair Company | $13,022 | $16,200 |
| W. & A. Fletcher Company | 13,930 | ..... |
| Theodore A. Crane's Sons Company | 15,580 | 17,138 |
| New York Harbor Drydock Company, Inc. | 15,636 | 17,236 |
| Staten Island Shipbuilding Company | 18,571 | 22,285 |
| Robins Drydock & Repair Company | 19,871 | 23,890 |

## S.S. West Loquassuck Repair Contract Awarded

BIDS were received in the New York office of the United States Shipping Board on September 6 covering repairs to the steamship *West Loquassuck*, and a contract was awarded to the Morse Drydock & Repair Company, Brooklyn, N. Y., at a price of $6422. Other bids received were:

| Name | Price |
|---|---|
| New York Harbor Drydock Company, Inc. | $6572 |
| W. & A. Fletcher Company | 6618 |
| Todd Drydock, Engineering & Repair Corporation | 7472 |
| Theodore A. Crane's Sons Company | 8087 |
| Staten Island Shipbuilding Company | 8474 |

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## Forty-Two New Vessels Planned by American Shipowners

PLANS for 42 vessels are now on the boards of the various naval architects throughout the country. Some of these proposals have already been submitted to shipyards for bids while others are still in the preliminary stage. Plans have been completed for 20 vessels while 22 are in the process of design. All of these, however, are definite projects that promise to materialize in the near future as a result of the passage of the Jones-White bill.

Yards on the west coast are preparing to obtain their share of the work that is planned by Pacific lines. Among these are two 22,000-ton, 20-knot passenger and cargo vessels for the Dollar Steamship Line, 311 California St., San Francisco, Cal. These are estimated to cost $7,000,000 each. The Matson Navigation Company, 215 Market St., San Francisco, Cal., has announced its intentions to construct two passenger and freight ships, 625 feet in length with a speed of 21½ knots, for their Australian line. The Inter-Island Steam Navigation Company, Honolulu, T. H., is planning two passenger and cargo steamships for their service.

The American South African Line, 39 Cortlandt St., New York city, is in the market for one vessel of 6000 gross tons and 13 knots speed. The Export Steamship Corporation, 25 Broadway, New York city expects to issue its plans for four passenger and cargo boats to the shipyards for bids within the next few weeks. The Colombian Steamship Company, 17 Battery Place, New York city, awaits the award of a mail contract before issuing its plans for three vessels to the shipyards for bids. The New York & Cuba Mail Steamship Company (Ward Line) Wall St., New York city, has plans in preparation for the construction of two fast liners. Bids for two ships for the Grace Line, Inc., 10 Hanover Square, New York city, have been received from the shipyards. The Di Georgio Fruit Company, 25 Broadway, New York city, has also received tenders for the construction of two new vessels.

A project for the construction of seven passenger, automobile, and car ferries for operation between Galveston, Tex., and New Orleans, La., is being planned by the Union Gulf Line, Galveston, Tex.

Two 250-foot tankers are being designed by a New York naval architect, and two 250-foot freighters are being designed for the "B" Line by Burgess & Morgan, naval architects, New York city. One tanker for the Union Oil Company of California, Los Angeles, Cal., is about to be constructed, bids having been taken.

The New England Steamship Company, New York city is receiving bids for the construction of one small vessel for operation on the New Bedford, Martha's Vineyard & Nantucket Steamboat Line, The Hudson River Navigation Company, New York city, has received bids for the construction of two passenger and cargo boats and it is expected that the contract will be awarded within the next 40 days.

Among the government construction projects are three lightships, bids for which have already been received by the Department of Commerce, Bureau of Lightship, Washington, D. C. The United States Coast & Geodetic Survey, Washington, D. C., has asked for bids for the construction of one small survey ship. Three cutters for the United States Coast Guard, Washington, D. C., are being planned at the present time. Bids will be asked at a future date.

## Contracts for Seven Ocean Mail Routes Awarded

POSTMASTER-GENERAL New has also awarded contracts for ocean mail service on seven routes on the Atlantic and Pacific Oceans. Operation of the services under the contracts will become effective October 1 and will run for a period of 10 years. All contracts call for the construction of new vessels.

The routes, the successful bidders and the contract price follow:

Route No. 16.—New York to Copenhagen: American Scantic Line, New York city; vessels of Class 6, $2.50 per nautical mile; Class 5, $4; Class 4, $6; Class 3, $8.

Route No. 17.—New York to ports on the West African coast: American West African Line, New York city; vessels of Class 6, $2.50 per nautical mile; Class 5, $4; Class 4, $6.

Route No. 18.—New York to Maracaibo, Atlantic & Caribbean Steam Navigation Company, New York city; vessels of Class 5, $4; Class 6, $2.50; Class 4, $6.

Route No. 21.—New York to Vera Cruz: New York & Cuba Mail Steamship Company, New York city; vessels of Class 5, $4; Class 4, $6.

Route No. 23.—Galveston to Santo Domingo: Lykes Brothers-Ripley Steamship Company, Inc., Galveston, Tex.; vessels of Class 6, $2.50; Class 5, $4; Class 4, $6.

Route No. 28.—Portland to Manila: States Steamship Company, Portland, Oreg.; vessels of Class 6, $2.50; Class 5, $4; Class 4, $6; Class 3, $8.

Route No. 29.—Portland to Darien: States Steamship Company, Portland, Oreg.; vessels of Class 6, $2.50; Class 5, $4; Class 4, $6; Class 3, $8.

## Cramp Marine Machine Shops Resume Operation

THE marine machine shops of The William Cramp & Sons Ship & Engine Building Company, Philadelphia, Pa., which have been idle since 1926 due to the closing of the shipyard, have been reopened and are now being occupied by the De La Vergne Machine Company, one of the six subsidiaries of Cramp-Morris Industrials, Inc. More than $2,000,000 worth of tools and inventory are being moved from New York to Philadelphia. By November they will all be installed in the Philadelphia buildings, offering employment for several hundred additional skilled workers.

For about forty years the De La Vergne Company occupied buildings covering approximately three city blocks at 138th street and the East River in New York city. When the marine machine shops of the original Cramp company were taken over by the Cramp Engine Manufacturing Company in Philadelphia, their utility in connection with the operation of the De La Vergne subsidiary was examined by the management. Existing facilities and those that will be added cover between three and four acres of floor space.

One hundred freight cars are being used for the transportation of equipment, and manufacturing is being carried on without interruption. At present the manufacturing is about equally divided between New York and Philadelphia. By November all work will be done in the Philadelphia plant.

## General Engineering Company Purchases Hanlon Drydock

THE General Engineering & Drydock Company, Alameda, Cal., recently purchased the Hanlon Drydock & Shipbuilding Company, Oakland. The purchase price was not announced officially, but it is believed to be in the neighborhood of $750,000.

George A. Armes, president of the General Engineering Company, announced that his company will install one of the largest forge presses in the world at the Oakland plant. The press will have a capacity of 1000 tons, which is 800 tons more than its nearest competitor on the Pacific Coast, and will handle any size of ship forgings. Shafts, stern frames and all of the great metallic structural parts of modern ships will be handled.

# Supply Trade

## Todd New Orleans Plant Expansion Completed

IMPROVEMENTS to the plant of the Todd Engineering, Dry Dock & Repair Company, New Orleans, La., have been completed. This expansion includes a wharf, shop, office building, boiler house and other accessory construction. The plant now awaits the arrival of a 12,000-ton electrically-driven dry dock, which will greatly increase the ship-repair facilities already existing in New Orleans harbor.

The new plant is an expansion of the present facilities of the company, which now occupy two city blocks. The company's total outlay on wharf, buildings and equipment has already amounted to approximately $1,000,000.

## Over 400 New Manufacturers Located in Newark, N. J.

A PHENOMENAL record has been established by the location of 417 new manufacturers in the Newark, N. J. industrial area, according to a survey just completed by the Newark Chamber of Commerce. The survey, conducted in collaboration with the Bureau of the Census of the Department of Commerce, covers the years of 1926 and 1927, and the first five months of 1928. It indicates 417 new manufacturers starting in business in the Newark area during the stated time, an average of more than 150 new manufacturers per year. This large number of new industries is divided into 333 firms located in Newark and 84 firms in the balance of the Newark industrial area, embracing Bloomfield, Belleville, Kearny, Harrison and the Oranges.

Co-operation, the development of additional rail terminals, and improvements of the waterways, augmented by an ample supply of fuel and electric power, as well as all other facilities necessary for the successful production of goods has made possible this rapid industrial growth in the Newark area.

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## Business and Personal

**Captain Edward Beetham,** for the last nine years general superintendent of the **Canadian Pacific Steamships, Ltd.,** with headquarters in Vancouver, has retired from active service, having reached the age limit of 65. **Captain Edmund Aikman** will succeed Captain Beetham.

The **W. S. Ray Manufacturing Company,** San Francisco, Cal., manufacturer of the Ray marine oil burner, is adding a new unit to its factory, 220 feet by 140 feet. Increasing business has made necessary additional warehouse, office and display room space. The new building will give the company an added 42,000 square feet.

The **Lincoln Electric Company,** Cleveland, O., announces the opening of a San Francisco office at 533 Market street in charge of **W. S. Stewart. L. P. Henderson,** formerly of the Chicago office, has been transferred and put in charge of the Minneapolis district. **Robert Notvest** has been transferred from Kansas City to Indianapolis where he will have charge of the Indianapolis district. **R. E. Mason** has been sent to Kansas City to replace Mr. Notvest. **N. L. Nye** has been stationed at Akron, O., under the direction of **R. P. Tarbell,** manager of the Cleveland district.

**F. M. Aday,** general sales manager of the **Jamison Cold Storage Door Company,** Hagerstown, Md., died September 7. Mr. Aday was a director of the American Society of Refrigerating Engineers and for twenty-three years was actively interested in refrigerating work. He began his life work in 1908 with the **Fred W. Wolf Company,** of Chicago. In 1914 he became manager of the Boston office of the **De La Vergne Machine Company,** and a year later was placed in charge of the sales division headquarters of the company in Philadelphia. From 1918 to October 1, 1927, Mr. Aday was in charge of the eastern sales staff of the **Arctic Ice Machine Company** with headquarters in New York. Last October he became general sales manager of the **Jamison Cold Storage Door Company** at Hagerstown.

## Trade Publications

FLOODLIGHTS.—The carbic light is described in a booklet issued by the Oxweld Acetylene Company of New York. Its application is seen anywhere that an economical portable floodlight is desired.

BLOCKS.—A catalogue has been received from W. H. McMillans' Sons, New York, in which their line of yacht blocks and fittings are described together with prices revised to April 1, 1928.

ROLLED METALS.—A booklet by this name has been received from J. F. Ratcliff, Ltd., Birmingham, England, in which is described the process employed in the manufacture of non-ferrous rolled metals.

INDUSTRIAL PIPING.—The Linde Air Products Company, New York, has issued a booklet "Oxwelded Industrial Piping" in which is described and clearly explained the economies in construction, repair and maintenance of oxwelded pipe systems.

LUBRICATION.—The Texas Company, New York, has issued its monthly bulletin "Lubrication" in which are discussed the factors which affect lubrication, covering bearing metals, oil grooving and methods of lubrication.

INDUSTRIAL METERS.—A bulletin describing Badger meters has been received from the Badger Meter Manufacturing Company of Milwaukee, Wis. The application of these meters comprises any field where liquid is to be measured.

LUBRICATORS.—"Lubrication for Safety and Economy" is the name of a new twenty-page booklet just published by E. F. Houghton & Company, Philadelphia, Pa. It relates to Houghton's absorbed oils and the Gun-Fil lubricator. It explains in detail why a proper oil feed is essential to greatest economy in lubrication.

WINTON NEWS.—The September issue of "Winton News," published by the Winton Engine Company, Cleveland, Ohio, describes the new yacht *Colleen,* designed by B. T. Dobson for Mr. Samuel A. Savage of New York. The new *Colleen* has a length overall of 150 feet; length on the waterline, 139 feet 9 inches; beam, 22 feet; draft, 7 feet 6 inches. She was built by the Pusey & Jones Corporation, Wilmington, Del., and powered by two 6-cylinder Winton Diesels developing 600 horsepower each.

PORT OF MILWAUKEE.—The Board of Harbor Commissioners, Milwaukee, Wis., has issued a Handbook of Information on the Port of Milwaukee. This booklet contains information in regard to the aids to navigation, municipal ordinances relative to navigation, transportation facilities and the various warehouses and shipyards at this port.

INSULATION.—Pennrich & Company, New York city, has issued a booklet on the subject of "Torfoleum," an insulating product now manufactured and widely used in Europe. The product is obtainable in this country in sheets 19½ inches wide by 39 inches long and in thicknesses from 1 to 6 inches. It has a thermal conductivity of 0.27 British thermal units per square foot per hour, per one degree temperature difference, per one inch of thickness.

CRAWLER CRANES.—The Link-Belt Company, Chicago, Ill., has published the Crawler Crane book No. 995, which covers the complete Link-Belt line of gasoline, Diesel and electric crawler cranes of capacities up to and including the two cubic-yard heavy-duty machine, as well as standard locomotive cranes. Data on lifting capacities, approximate operating speeds, line pull, and tractive effort are given. The tables have been supplemented by line drawings which show dimensions for operating limits.

## Marine Societies

### America

**American Marine Association,** 30 Church St., New York. President—Col. E. A. Simmons.

**American Marine Standards Committee.** Chairman, Colonel E. A. Simmons. Secretary, A.V. Bouillon, Division of Simplified Practice, Department of Commerce, Washington, D. C.

**American Society of Marine Designers.** Secretary—B. G. Barnes, 202 Kendrick Ave. Quincy, Mass.

**American Society of Marine Engineers.** 605 Market St., San Francisco, Calif. President—James Bullock. Secretary—W. H. Thille.

**American Society of Naval Engineers.** Navy Department, Washington, D. C. Secretary and Treasurer—Captain O. L. Cox, U. S. N., Bureau of Engineering, Navy Department, Washington, D. C.

**American Steamship Owners' Association,** 11 Broadway, New York. President—H. B. Walker.

**Atlantic Coast Shipbuilders' Association.** 1600 Walnut Street, Philadelphia, Pa. Secretary—C. S. King.

**Jersey Marine Club,** 4th and River Streets, Hoboken, N. J. Secretary—Fred L. Broad.

**Lake Carriers' Association.** President—J. S. Ashley. Secretary—George A. Marr, Rockefeller Building, Cleveland, O.

**National Association of Engine and Boat Manufacturers,** 420 Lexington Avenue, New York City. Secretary—Ira Hand.

**National Association of Masters, Mates and Pilots.** National Secretary—M. D. Tenniswood, 308 Vine St., Camden, N. J.

**National Council of American Shipbuilders,** Inc., 50 Broadway, New York. President—Homer L. Ferguson. Secretary-Treasurer—Henry C. Hunter.

**National Marine Engineers' Beneficial Association.** Headquarters 311-315 Machinists Building, Washington, D. C. President—Wm. F. Yates. Secretary—Albert L. Jones.

**Neptune Association,** 21 Pearl St., New York City. Secretary-Treasurer—Captain John F. Milliken.

**New York and New Jersey Dry Dock Association.** 111 Broadway, New York. President—Jonathan Moore.

**Ocean Association of Marine Engineers.** 15 Whitehall St., New York. Secretary—Bert L. Todd.

**Port of New York Authority,** 75 West Street, New York. Chairman—George S. Silzer. Secretary—Wilson J. Vance.

**Society of Naval Architects and Marine Engineers,** 29 West 39th Street, New York. Secretary and Treasurer—Daniel H. Cox.

**The Maritime Association of the Port of New York,** 78 Broad St., New York City. President—John Dowd. Secretary—John F. Manning.

**The New York Tow Boat Exchange,** 11 Moore St., New York. Manager—Langdon W. Smith.

**The Propeller Club of the Port of New York.** President—E. M. Roberts, New York. Secretary—W. Z. Gardner, 136 Liberty Street, New York.

**United States Naval Institute.** Naval Academy, Annapolis, Md. Secretary and Treasurer—Captain H. A. Baldridge, U. S. N.

**United States Ship Operators' Association,** 149 Broadway, New York. President—Winchester Noyes.

### Canada

**Grand Council N. A. of M. E. of Canada.** Grand Secretary-treasurer—W. A. MacDonald, 62 Albert St., Halifax, N. S.

### Great Britain

**Institute of Marine Engineers Incorporated,** 85-88 The Minories, London E.1.

**Institution of Engineers and Shipbuilders in Scotland,** 39 Elmbank Crescent, Glasgow.

**Institution of Naval Architects,** 2 Adam Street, Adelphi Terrace, London, W. C.

**North East Coast Institution of Engineers and Shipbuilders.** Bolbec Hall, Westgate Road, Newcastle-on-Tyne.

### France

**Association Technique Maritime et Aëronautique.** Secrétariat Genéral—7, rue de Madrid, Paris (8e).

### Italy

**Collegio Degli Ingegneri Naval e Meccanici In Italia.**

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